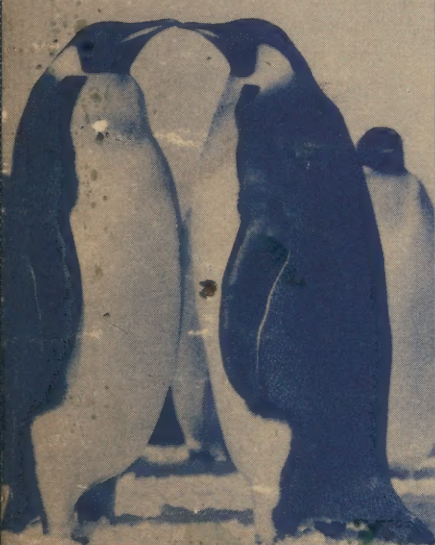


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ARMY OBSERVERS' REPORT OF OPERATION

HIGH JUMP



TASK FORCE 68, U.S. NAVY

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ARMY OBSERVERS' REPORT

OF

OPERATION
HIGHJUMP

TASK FORCE 68, U. S. NAVY

U.S. War Dept. General Staff

1300

WAR DEPARTMENT, WASHINGTON, D. C.

SEPTEMBER 1947

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PREFACE

This report represents the combined observations of Army personnel assigned to Task Force 68, Operation "HIGHJUMP", Naval Antarctic Development Project, December 1946 to April 1947. The War Department responded willingly to a Navy invitation to send observers on this important expedition and increased its representation to sixteen, ten more than originally allotted by the Navy. (The personnel included four men with prior Antarctic experience.)

The Army cooperated with the Navy in respect to matériel items, particularly in regard to Ordnance vehicles and Quartermaster items of issue including special rations, tents, skis, stoves, sleeping bags, and cold weather clothing.

The Army observers were primarily a cross-section representing Army Air Forces, Army Ground Forces, and some of the technical services. The combined background permitted a general coverage of primary Army interests, particularly in the fields of polar research, engineering, communications, personal health and protection, surface transportation, meteorology, photography, air operations, emergency rescue, and various fields of scientific research.

By Navy request, the Army observers' activity was to be segregated specifically from expedition operations. However, they asked for or accepted voluntary work assignments which would permit better opportunities for military observations. The Army personnel therefore had an active part in many operational activities including exploratory flights, air operations, base construction, photography, over-snow travel, meteorology, emergency rescue planning, training, scientific projects, and other activities.

The Army observers were concentrated for the most part with the Central Group which operated on the Ross Shelf Ice, as there was little of concern to the Army in respect to ship movements and seaplane activity of the Eastern and Western Groups. The War Department issued no special instructions to its observers, but appointed a senior observer who was well qualified as to the broad interests of the Army in high latitude operations and thoroughly cognizant as to Antarctic conditions. The senior Army observer organized the observation team and clarified fields of responsibility. The trip to Antarctica aboard the U. S. S. *Mount Olympus*, Flagship of the Task Force, was spent in frequent conference to prepare for maximum utilization of observation opportunities in the Antarctic. The plan worked smoothly while on the ice permitting the observers to work independently with only occasional coordination with the senior observer. On the return, the observers held daily conferences and prepared

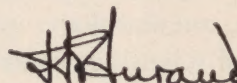
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necessary joint logs and reports by means of dictation into a wire recorder. The specific topics for which the observers were individually qualified and responsible were prepared separately.

Within one week upon return to the United States the Army observation reports, in rough draft, including illustrations, were submitted to the War Department and were made available in most instances to the agencies primarily concerned. The publication of the combined Army observers' report was purposely postponed until the Navy's much larger report could have prior release. It is felt that the Army observers' report, although it does not attempt to cover ship operations or problems of primary concern to the Navy, does contain many valuable independent observations from an Army viewpoint that do not constitute a duplication of the Navy's "Report of Operation Highjump". (U. S. Navy Antarctic Development Project 1947.)

The Army's combined observers' report has in no manner attempted to evaluate or criticize the Navy's Operation Highjump. It has been a conscientious effort to report the operation as planned and executed. Each contributor was requested to consider the operation in the light of the problems with which the Army would be faced, were it to undertake a similar project, and to make recommendations as to how difficulties could be obviated.

The War Department is indebted to the Navy for including Army observers on Operation Highjump under the commendable leadership of Rear Admiral R. E. Byrd and Rear Admiral R. H. Cruzen. The Army observers, and those who have assisted in production of this report, are to be commended for the very valuable contributions they have made to the War Department research and development program.



H. S. AURAND
Major General, GSC
Director of Research & Development
War Department General Staff

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Top row: Maj. Crozier; Capt. Harrison; Mr. Waite; Dr. Siple; Maj. Holcombe; Capt. Wiener; Lt. Col. Davis. Bottom row: T/5 Waltersdorf; T/5 Shimberg; Lt. Col. Love; CWO Morency; Mr. Davis; Sgt. London; Lt. Col. Johns

Figure 1. Army observers assigned to U. S. Navy Task Force 68, Operation "HIGHJUMP"

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CHAPTER 1

INTRODUCTION

SECTION I. Planning of Operation "HIGHJUMP"

1. Command of Project.

The United States Navy's "Antarctic Development Project, 1947," identified by the code word HIGHJUMP, was established by the Chief of Naval Operations to be carried out by Task Force 68 of the Atlantic Fleet. This force, commanded by Rear Admiral Richard H. Cruzen, was under the operational and administrative control of the Commander in Chief, U. S. Atlantic Fleet. Technical control was retained by the Chief of Naval Operations and exercised through Rear Admiral Richard E. Byrd, USN (Ret.), who was designated as the officer in charge of the project and during the conduct of operations exercised technical control. Tactical command at all times remained with the Commander Task Force 68.

2. Assumptions.

- a.* That ice conditions would permit access to the proposed operating areas.
- b.* That weather conditions encountered would permit conduct of planned air and surface operations.
- c.* That no vessels of the task force would spend the winter in the Antarctic.

3. Objectives of Project

- a.* To establish a temporary base and airstrip on the Ross Shelf Ice in the vicinity of Little America, Antarctica, and conduct systematic long range air exploration of the

Antarctic Continent therefrom, and conduct naval operations and carry out specific projects for training naval personnel, testing materials, and amplifying scientific knowledge of the Antarctic.

- b.* To extend the area of exploration of the Antarctic Continent, utilizing aircraft based on tenders operating around the continental perimeter.

- c.* To examine the limits and character of the ice belt surrounding the Antarctic Continent and the coast line where accessible by surface ships.

- d.* To carry out assigned naval and scientific projects in order to—

- (1) Train personnel and test matériel in the frigid zones.

- (2) Explore the largest practicable area of the Antarctic Continent.

- (3) Determine the feasibility of establishing, maintaining, and utilizing bases in the Antarctic, and investigate possible base sites.

- (4) Develop techniques for establishing, maintaining, and utilizing bases on ice, with particular reference to later applicability of such techniques to operations in interior of ice caps where conditions are comparable to those in the Antarctic.

- (5) Amplify existing stores of knowledge of hydrographic, geographic, geological, meteorological, and electromagnetic propagation conditions in the area.

- (6) Supplement objectives of the 1946 NANOOK operation.

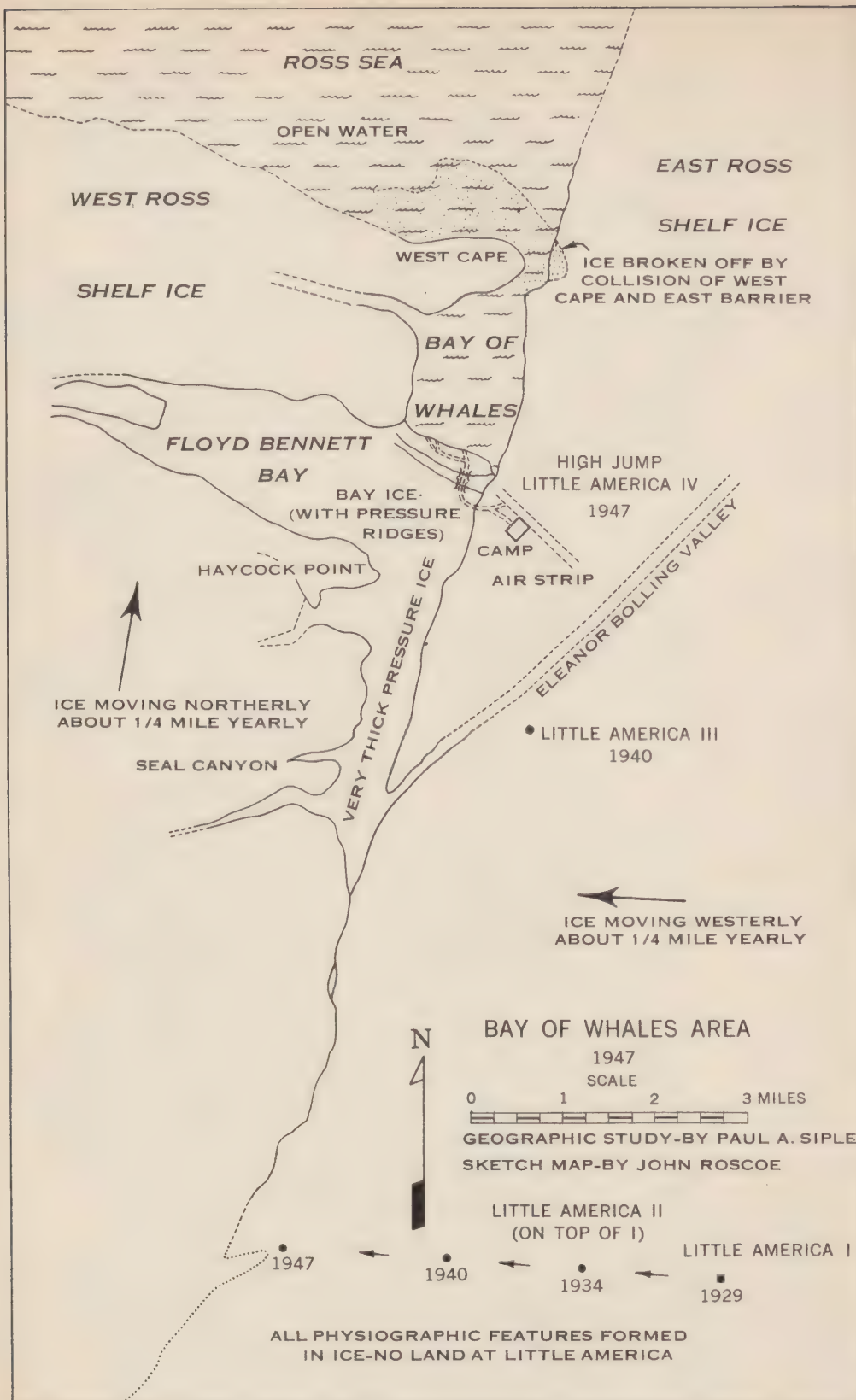


Figure 2. Bay of Whales area, January 1947.

4. Task Force Composition.

Task Force 68 was subdivided into four task groups with the following locations and objectives:

a. Central Group. The Central Group was composed of the following vessels:

- 1 Communications Ship (AGC), the U. S. S. *Mount Olympus* (Flagship).
- 1 Ice breaker, "wind class" (WAG), the U. S. C. G. C. *Northwind*.
- 1 Ice breaker (AG), the U. S. S. *Burton Island*.
- 2 Supply ships (AKA), U. S. S. *Yancey* and U. S. S. *Merrick*.
- 1 Submarine (SS), U. S. S. *Sennet*.

This task group was to proceed to the Bay of Whales, land and establish a temporary base and airstrip in the vicinity of Little America, conduct systematic long range air exploration and associated operations, carry out various training and test projects, and support scientific investigations in the interests of amplifying our knowledge of the Antarctic.

b. Western Group. The Western Group was composed of the following vessels:

- 1 Seaplane tender (AV), the U. S. S. *Currituck*.
- 1 Tanker (AO), the U. S. S. *Cacapon*.
- 1 Destroyer (DD), the U. S. S. *Henderson*.

c. Eastern Group. The Eastern Group was composed of the following vessels:

- 1 Seaplane tender, the U. S. S. *Pine Island*.
- 1 Tanker, the U. S. S. *Canisteo*.
- 1 Destroyer, the U. S. S. *Brownson*.

This task group was to proceed to the vicinity of Peter I Island (69° S. latitude and 91° W. longitude) and from this location begin systematic air exploration of assigned areas of the continent and coast line. This area was to be covered by moving eastward along the continental perimeter, keeping just outside of the ice pack.

d. Carrier Group. In addition to the above one aircraft carrier, the U. S. S. *Philippine Sea* was to ferry the R4D aircraft and one

HO3S helicopter down to the limits of the ice pack from which point the R4D aircraft were to be flown southward over the Ross Sea to the airstrip on the ice shelf. The helicopter was to be carried within range of Little America aboard the ice breaker *Northwind*.

5. General Concept of Operations after Arrival.

The primary objectives of the expedition were: To explore and map by aerial reconnaissance and photography as much of the unexplored and unmapped portions of the interior as possible and certain unknown or improperly charted parts of the coast line; to test cold weather air operations from ice cap terrain with conventional wheel landing gear by constructing and using a matted airstrip; and to determine the feasibility of and develop techniques for establishing, maintaining, and utilizing air bases on ice. To these ends the various phases of the operation were planned as follows:

a. Base Site. The ice barrier was to be approached in the Bay of Whales area and a thorough investigation made to locate a feasible base site in that area. If the bay was found closed and the area unsuitable for landing, search was to be made along the barrier, aided by observation from the helicopter carried aboard the U. S. C. G. C. *Northwind*. The site selected had to satisfy the following requirements:

(1) The top of the barrier must be accessible from the ice, foot or bay ice.

(2) The general area had to be one in which the ice showed minimal signs of a tendency to break off.

(3) The terrain must present a level straightaway 1 mile long for the airstrip.

b. Base Construction. The senior Civil Engineer Corps officer was to be responsible for construction of the base and airstrip. All construction was planned to continue

on a 24-hour basis. The following priorities were given to the various phases of establishing the base:

(1) *Priority One.* Construct an access roadway from the ship's side to a place of safety on top of the barrier, set up rigging to move cargo sleds from ship to barrier top, establish an emergency subsistence facility on the barrier top, and install communications for local control of unloading and construction.

(2) *Priority Two.* Break a trail from the first supply and equipment depot on the barrier top ("place of safety" mentioned above) to the base camp site.

(3) *Priority Three.* Erect a 300-man temporary tent camp.

(4) *Priority Four.* Install air operating facilities such as quonset hut for service facilities, radio equipment, and the pierced plank landing mat 150 by 5,000 feet with parking area, fuel dump, and runway lights.

(5) *Priority Five.* Erect 35-man emergency winter hut camp.

(6) *Priority Six.* Special facilities for testing equipment under cold weather conditions.

c. *Carrier Group Operations.* Upon completion of the airstrip (estimated late January) two R4D aircraft were to be called from the carrier lying outside of the ice pack at about 70° S. latitude and 175° W. longitude. These planes were to make the flight and test the landing strip before the balance of the R4D aircraft were called. The destroyer *Henderson* was to act as plane guard during the launching operation. After ferrying and launching the aircraft, no further role was planned for the carrier which was then to be released for return to the Canal Zone. The helicopter on the *Philippine Sea* was to be brought in to within flying distance of the base site aboard the U. S. C. G. C. *Northwind*.

d. *General Air Plan.* (1) After the aircraft from the carrier had joined the central group the planes available at the main base would be the following:

6 R4D (C-47)—based ashore.

1 JA (C-64) on skis—based ashore.

1 HO3S (commercial type) helicopter—based ashore.

2 J2F (amphibians)—one on U.S.C.G.C. *Northwind* and one on U.S.S. *Burton Island*.

1 HOS (R-6) helicopter—based on the U.S.C.G.C. *Northwind*.

1 HO3S helicopter—based on the U.S.S. *Burton Island*.

2 Or (L 5) based ashore.

With this equipment systematic exploration within the limits of practicable flight by the specially modified R4D aircraft was to be carried out. The range of these aircraft with cabin tanks was estimated at 750 miles' radius. It was intended to fly standard sector search tracks spaced so that adjacent plane tracks at the end of the sector would be no more than 60 miles apart. The planes were oxygen equipped and where possible were to fly at 10,000 feet altitude over the average terrain level while taking trimetrogon photographs. All R4D's were to be modified to a combination ski-wheel landing gear. The smaller aircraft were earmarked for rescue and short range reconnaissance.

(2) The Eastern and Western Task Groups each had available the following aircraft:

3 PBM-5 seaplanes...	} Western—all on U. S. S. <i>Currituck</i> .
1 HOS (R-6) helicopter.....	
1 SOC seaplane.....	} Eastern—all on U. S. S. <i>Pine Island</i> .
1 HO3S helicopter...	

The helicopters and seaplanes were to be used for rescue and short range reconnaissance. The PBM aircraft were to be used in pairs to conduct exploration of assigned areas. Each group was to move gradually in a direction away from the Ross Sea area along the continental perimeter. They were to concentrate on areas outside of a 750-mile circle from the Central Group's base. Flights were to cover the coast line first in order to provide maximum geographical reference for succeeding flights

into the interior. After photographing the coast line, flights were to be made into the interior up to 700 miles from the ships. General areas covered are indicated on map, appendix VIII.

e. Withdrawal. When the season advanced to the more difficult weather of the Antarctic fall, making air operations unprofitable or impracticable (estimated late March) ships of the Central Group were to be loaded and cleared from the Ross Sea and the entire task force withdrawn from the Antarctic area for return to the United States.

f. Emergency Base. It was planned that no personnel would remain in the Antarctic except to continue a rescue operation. If this became necessary the winter party of about 35 men and officers would be chosen

insofar as possible from volunteers and would occupy the emergency camp mentioned above as fifth priority in the base construction plan. If possible this camp was to be located so as to utilize the buildings left by the U. S. Antarctic Service Expedition in 1941 ("3rd Byrd Expedition"). The complement of the emergency camp was planned to include one medical officer and one medical enlisted man.

g. Scientific Research. As auxiliary activities many scientific projects were to be pursued in such fields as geology, meteorology, terrestrial magnetism, oceanography, radar propagation, etc. Certain of these projects were under the direction of civilian scientists from nonmilitary governmental agencies.

SECTION II. Activities of U. S. Army Observers

1. Personnel.

The personnel serving as War Department observers on Operation HIGHJUMP, together with the agencies they represented were as follows:

Dr. Paul A. Siple, civilian, WDGS, Research and Development (Assistant to Admiral Byrd on technical matters).

John N. Davis, Lt. Col., Inf., Infantry School (Airborne).

Willis S. Johns, Lt. Col., A. C., AAF Communications.

R. C. Love, Lt. Col., M. C., AAF, The Air Surgeon.

James H. Holcombe, Maj., C. E., AAF, The Air Engineer.

Dan Crozier, Maj., M. C., Brooke Army Medical Center.

Mr. A. H. Waite, civilian, Chief Signal Corps and Signal Corps Engineering Laboratory.

Murray A. Wiener, Capt., A. C., AAF Rescue Service.

Chas. H. Harrison, Capt., A. C., AAF, Weather Service.

Mr. Robert Davis, civilian, Strategic Air Command (radar mapping observer).

S. A. London, 1st Sgt., AAF Rescue Service (paratrooper).

A. J. L. Morency, C. W. O., Amphibious Engineers.

In addition to the above, four U. S. Army enlisted photographers were on the expedition as participants under Navy direction. They were: Cpl. J. M. Waltersdorf and Cpl. J. Shimberg, central group; Cpl. H. C. Foster, Western group; and Cpl. E. Zinberg, Eastern group.

2. Policies of the Commander, Task Force 68.

The policies of the Commander Task Force 68 with reference to the activities of the Army observers were as follows:

a. Army observers were not to participate

in the operation or the projects set up for accomplishment by the Navy Department. Their capacity as observers only was maintained except as requested by the task force staff.

b. In order that the final report on HIGH-JUMP might be as complete and comprehensive as possible, it was directed that observers submit their official reports to or via the Task Force Commander. If desired, observers were given the choice of submitting advance copies of their reports to interested addressees. The Task Force Commander was to be informed of advance copies so distributed.

c. Commanders were directed to furnish the Army group with all information and assistance possible in the furtherance of their mission.

d. Complete photographic coverage of all aspects of the operation was planned, and any additional photographic work desired by Army observers was to be made available.

3. Planning of Activities.

Planning of observers' activities was initiated after departure from Balboa, C. Z. Regular meetings of all Army personnel were scheduled three times a week, and plans were drawn up for coverage of all task force projects and activities.

a. A master chart listing all major activities and subdivisions thereof was prepared in such a way as to indicate the primary, secondary, and minor interests of each observer in the various phases of the operation. The master chart included official Navy test and research projects and in addition many routine phases of the operation which it was believed would yield valuable information. The medical officers submitted a jointly prepared outline of subjects to cover which became the medical section of the Army project list.

b. It was decided that a final consolidated report to the War Department would be

written on the return journey from material assembled by the various observers. Each Army observer wrote the sections for which he had been originally assigned and considered best qualified. These assignments carried with them the responsibility for detailed observation and final preparation of material for the consolidated report.

c. It was believed preferable that most Army observers live ashore from the earliest possible date in close contact with the operation. Accordingly, a memorandum was submitted to the Chief of Staff, Task Force 68 requesting that this be authorized. Subsequently the task force commander directed that during the early phase of unloading supplies and building the airstrip, only personnel essential to the actual progress of the work would be quartered on the ice. All other personnel, both Navy and Army, were to sleep aboard ship. During this period the presence of these officers on the ice was to be permitted insofar as it did not place a burden on the shore party in erecting tent quarters, expanding the mess to accommodate them, etc. See Task Force Memorandum, this subject, appendix II. Exception to this policy in connection with the War Department observers was made in the case of Maj. Holcombe, Aviation Engineer observer, who was invited to assist by participating in the operation in his field and was authorized to quarter ashore at any time at the discretion of the senior naval engineering officer. Other Army personnel were to be quartered ashore after the landing and construction phases.

d. In view of the detailed and complete photo coverage of all kinds planned for the expedition it was the hope of the medical observers that a moving picture covering the medical support of the operation might be assembled. The privilege of requesting photographic coverage was extended to the Army group and a comprehensive list of medical subjects was submitted.

e. It was foreseen that many of the data assembled by various observers would require interpretation and correlation with the weather conditions prevailing when the observations were made. The AAF Weather Service observer was assigned the responsibility for obtaining and recording daily information on temperature, wind, cloud cover, etc.

4. Activities Ashore.

Most Army observers made daily visits ashore until 23 January when tent quarters were made available and were occupied from that date until the shore party was evacuated on the U. S. C. G. C. *Burton Island*. Information was gathered principally through the medium of daily contact with personnel of the base camp. Press conferences were not attended by Army observers, with the exception of a few instances. Each air crew member was interrogated after all

major flights. Engineering officers, crew chiefs, and line mechanics were also contacted on matters relating to their work activities. Permission was obtained from the base commander and senior officer of the flight echelon to attend aircrew briefings, and this was done whenever possible. Major Dan Crozier, M. C., and C. W. O. Anthony J. L. Morency were members of the party which made a week's trip to the Rockefeller Mountains in tracked vehicles.

5. Recommended Assignments of Army Observers.

The following memorandum from Dr. Paul A. Siple, Senior War Department Observer, to Capt. R. S. Quackenbush, USN, Chief of Staff, Task Force 68, outlined the recommended assignments for the Army observers while with the Task Force on Operation Highjump:

18 December 1946

Aboard USS Mount Olympus

MEMORANDUM TO: Capt. R. S. Quackenbush, U. S. N., Chief of Staff, Task Force 68, Operation "HIGHJUMP".

FROM: Dr. Paul A. Siple; Senior War Dept. Observer, U. S. Army.

SUBJECT: Recommended assignments of Army Observer personnel during phase I of Ice Operations (Prior to arrival of R4D aircraft).

1. The following recommendations are summarized from detailed observation plans now under preparation to be submitted at a later date. Army Observer personnel are sincerely interested in the success of Operation "HIGHJUMP" and are willing, individually or collectively, to be of such assistance to the Task Force Commander as he might desire, insofar as they are capable, providing, of course, that such possible assignments permit ample opportunity to carry out observations of their specifically assigned fields by the War Department. The following list of Army Observer Personnel is given by name, showing individual primary interests and personal choice of location:

A. Dr. Paul A. Siple, W. D. G. S.:

(a) To be available at all times for advice as desired by the Officer in Charge and the Commanding Officer of Task Force 68, on subjects pertaining

to Antarctic Geography, safety of personnel and general operations ashore, including scientific research program.

(b) To be available to assist the Task Force Commander in selection of suitable safe sites for various operations on the ice.

(c) To observe physical factors related to the construction of the airstrip.

(d) When not occupied with (a), (b), and (c) above, to accompany members of the scientific group concerned with studies and surveys of the deformation of the Ross Shelf Ice.

(e) To observe factors of human adaptations, acclimatization, accustomization, clothing protection, climatic effects and carry out personal experimentation on radical clothing designs.

(f) To take such opportunities as may be provided to carry out visual observations from the air, to continue previous studies of the morphology of the glaciation of Antarctica and its general geographic structure.

CHOICE OF LOCATION:

(1) As desired by Admiral Cruzen.

(2) At the airstrip camp.

(3) With the bivouac camp for scientific group, planning to study ice deformation.

(4) Aboard ship.

B. Lt. Col. Robert C. Love, M. C.:

(a) Primary interest concerns general and specific problems of aero-medical and general medical nature. This latter will include all phases of health, sanitation, preventive medicine, casualties, acclimatization, clothing protection, accustomization, psychological factors, fatigue and endurance, food and water supply, observation of medical facilities and methods used ashore, including evacuations, etc. In order to make these observations during phase I of the Ice Operations, prior to the arrival of the R4D aircraft, it is desired that Col. Love and Major Crozier, listed below, be permitted to live with the shore party, so that they may experience the actual living conditions on a twenty-four hour basis. To this end, they are both willing to accept physical assignments to maintain close contact with working and construction parties who are subjects of their observations. It is assumed that if such assignments are made, they will be of such nature as to permit adequate time to make and record observations. Of special regard to Col. Love and Major Crozier, commuting from the ship daily will interfere with their personal acclimatization and accustomization, thus making poor observers and, as well, remove them for important hours each day from their subjects.

(b) After the arrival of the R4D aircraft, Col. Love desires to transfer his primary interest to subjects of aero-medical nature, while Major Crozier will continue to have a primary interest in human and medical problems of shore based personnel.

CHOICE OF LOCATION:

(1) At the airstrip camp.

(2) Self-provided bivouac near the airstrip camp.

(3) Aboard ship.

C. *Lt. Col. John N. Davis, Inf.:*

(a) Primary interest concerns all types of operations to be carried on ashore, especially landing and tracked vehicles' performance; observations of Ordnance and Chemical Warfare tests, portable field communication equipment, and general utilization of manpower and techniques for meeting problems for operations of the Ice. He will be assisted in observations of performance of automotive vehicles and transportation problems by C. W. O. Anthony Morency, Ord., after Mr. Morency's arrival on the Ross Shelf Ice.

(b) Desires permission (verbally indicated to Task Force Commander) to make a short flight for the purpose of testing airborne troop type parachutes in vicinity of the base airstrip. Col. Davis will be assisted and joined in actual parachute jump by 1st/Sgt. Jack London, USAAF, ATC.

(c) Included in Col. Davis's field of interests covering observations for the Army Ground Forces are tests on landing force equipment, BUORD PROJECT 1 (i) and technique and principles of dog sledging.

CHOICE OF LOCATION:

(1) At airstrip base camp.

(2) At ship.

D. *Lt. Col. Willis S. Johns, Air Corps:*

(a) Primary field of interest is that of communications, including all aspects generally and many specifically. Some observations will be made jointly with Mr. Amory Waite, Signal Corps. Because of the nature of the first phase, being primarily communications between ship and shore, Lt. Col. Johns can probably best carry out his observations by living aboard ship, with occasional trips ashore.

(b) After arrival of R4D aircraft, Lt. Col. Johns' primary interest will shift to communication problems and tests related to the flight operations.

(c) Of special interest are problems of task force organization and personnel handling, commands, and assignments.

(d) Observations to include general operations of aircraft, including cold weather techniques of flight preparations, aircraft performance, communications, and navigation.

CHOICE OF LOCATION:

(1) Aboard ship.

(2) At base camp after arrival of R4D aircraft.

E. *Major James H. Holcombe, Air Corps Engineer:*

(a) Observe and participate in construction of airstrip and advanced air base on Ross Shelf Ice. It has been indicated informally that Major Holcombe's services as an air engineer consultant and as an officer to assist in construction of the airstrip may be requested, and to this end he is willing to cooperate to the fullest extent. This would permit him to be billeted ashore where he can best observe while helping in his primary field of interest.

(b) Observe tests, performance, and suitability of standard construction equipment, materials, vehicles, fuels, and lubricants.

(c) Observe cargo handling and unloading.

(d) Determine physical characteristics of possible future air base sites.

(e) Observe demolition operations in icefields if such prove necessary, or are attempted for test purposes. If such procedure is contemplated, Major Holcombe would appreciate being placed on the ship most likely to carry out this work, providing that such temporary assignment would not interfere with other observation activities listed above, in order of their importance to this observer.

CHOICE OF LOCATION:

- (1) At airstrip base camp.
- (2) Self-provided bivouac near airstrip base camp.
- (3) Aboard ship

F. Major Daniel Crozier, M. C.:

(a) Primary observation interests are the same as listed for Col. Love, with the exception that primary interest concerns ice based personnel.

CHOICE OF LOCATION:

- (1) At airstrip base camp.
- (2) Self-provided bivouac near airstrip base camp.
- (3) Aboard ship.

G. Capt. Charles H. Harrison, Air Corps:

(a) Meteorological observations, analysis, interpretation, and predictions. To this end, it is understood that Capt. Harrison will work in close coordination with the meteorological program and is willing to assume such responsibilities as may be assigned to him in this field.

(b) To observe and record physical characteristics of the environment of Antarctic conditions which produce effects upon man, equipment, and operations.

CHOICE OF LOCATION:

- (1) Aboard ship.
- (2) At the airstrip base camp.

H. Capt. Murray A. Wiener, Air Corps:

(a) To observe all aspects of search and rescue operations, including air, sea, and ice. These observations will include problems concerning communication and aids, transportation study, to include land and ski-type aircraft, helicopters, small boats, over-snow vehicles and utilization of dogs and sleds; evacuation and care of personnel and casualties, emergency equipment and use of equipment.

(b) To offer assistance to the Task Force Commander and advice, as requested, based upon prior experience on above-mentioned subject and experience gained on former polar expeditions.

(c) To observe and record aspects of clothing protection and general personnel requirements for operations in Antarctica.

(d) To aid scientific group, when not occupied with higher priority studies.

CHOICE OF LOCATION:

- (1) At airstrip base camp.
- (2) Self-provided bivouac near airstrip base camp.

(3) With bivouac camp for scientific group.

(4) Aboard ship.

I. *Mr. Amory Waite, Signal Corps:*

(a) To observe installation, operation, and maintenance of all radio equipment, particularly as affected by cold weather and Antarctic environmental conditions.

(b) To observe the same factors in regard to meteorological and photographic materials and equipment.

(c) To observe generally and specifically the technical performance of all types of communications, electrical and electronic equipment, batteries, and items of issue by the Signal Corps, as utilized by the Task Force.

(d) To be available as desired by the Commanding Officer of the Task Force for advice and assistance on subjects listed above and general problems concerning Antarctica operations as previously experienced.

(e) In the early phase of the operation, temperatures will not be sufficiently low to make most of the desired observations listed above. He has therefore offered his services to the scientific group studying the deformation of the shelf ice. As an alternate to this suggestion, Mr. Waite has suggested he accompany the ship, if approved, which will erect the automatic weather station, possibly at Coleman Island, to cover observations of meteorological equipment and communications.

CHOICE OF LOCATION:

(1) Bivouac camp with scientific survey party.

(2) On ship, erecting automatic weather station and resultant shore party.

(3) At airstrip base camp.

(4) Aboard ship.

J. *C. W. O. Anthony B. Morency, Amphibious Engineers:*

(a) To observe all phases automotive equipment and to assist Col. Davis in general observations of specific interest to U. S. Army Ground Forces. This is contingent upon his transfer from the U. S. S. *Cacapon* to the Mount Olympus and the Central Group.

(b) His services based upon past Antarctic experiences are available as may be desired by the Task Force Commander.

CHOICE OF LOCATION:

(1) At airstrip base camp.

(2) Aboard Mount Olympus.

K. *1st Sgt. S. A. London, Air Corps:*

(a) To assist with observation program concerning search and rescue listed above under Capt. Wiener.

(b) To assist the program of testing Army type paratroop equipment as listed above under Col. Davis.

(c) Services available as so desired by Task Force Commander for search and rescue operations as based upon specific training under the Army Air Trans-

port Command for this type of work, including parachuting, trail work, and dog driving and driving of over-snow vehicles.

(d) When services not required as listed above, Sgt. London is available to assist scientific party studying deformation of shelf ice.

CHOICE OF LOCATION:

- (1) Airstrip base camp.
- (2) Self-provided bivouac with scientific party.
- (3) Aboard ship.

L. *Pvts. J. Shimberg and J. M. Waltersdorf, Signal Corps:*

- (a) Assigned to Photographic staff of Task Force 68.
- (b) To observe performance of photographic equipment and materials under operating conditions.
- (c) Maintain photographic record of subjects in official files of specific interest to the Army observation program.

CHOICE OF LOCATION:

- (1) As determined by Chief, Photographic Staff.
- (2) Airstrip base camp.
- (3) Aboard ship.

M. *Mr. Robert L. Davis, Air Corps:*

(a) It is anticipated that Mr. Davis will join the Central Group from the U. S. S. *Philippine Sea* by accompanying Rear Admiral R. E. Byrd or by P2V's. If in the latter case, he will have specific assignment of radar member of crew under Commander Davies. If in the former case, his interests will be as follows:

(1a) Observation and consultant on all aspects of radar and electronic equipment.

(1b) Observation on all phases of high latitude aerial navigation, aerial photography, mapping, and interpretation.

(1c) Observation on all phases of physical research and test performed by the Task Force.

CHOICE OF LOCATION:

- (1) With aviation detachment at airstrip base camp.
- (2) Aboard ship.

PAUL A. SIPLE

Senior War Dept. Representative

SECTION III. Narrative Account of Operation "Highjump"*

The flagship of the task force, U. S. S. *Mount Olympus*, sailed from Norfolk, Virginia, with the U. S. S. *Pine Island*, U. S. C. G. C. *Northwind*, and U. S. S. *Browson* on 2 December 1946. The voyage of 5 days to the Panama Canal was uneventful. Transit of the Canal was made in the afternoon and early evening of Saturday, December 7th and shore leave in Balboa and Panama City was authorized over the week end. Departure from the Canal Zone was made December 10th, and the equator was crossed on the 12th. The passage from latitude 40° S. to Scott Island (near 180° W. longitude and the Antarctic Circle) was relatively calm considering the reputation these waters have for extremely heavy weather. Naval foul weather gear was issued to all hands at about 45° S. but was used very little until the force turned south from Scott Island. Talks on subjects relating to living and operating on the Antarctic continent were given to both officers and men by personnel with experience on previous Byrd Expeditions. Training films on a wide variety of medical subjects were shown in the sick bay to medical and other interested personnel almost every day between the equator and the Ross Sea.

The first whales were sighted on Christmas day and the first iceberg the following day at about 60° S. latitude.

The ports of departure and sailing dates of task force vessels and necessary refueling operations precluded all vessels' making the trip in their assigned groups. Some vessels of the Eastern and Western Task Groups went almost direct to their assigned operating areas. Others met at Scott Island, and the

final disposition by groups as planned was made subsequent to this rendezvous. In the vicinity of Scott Island a refueling operation was carried out, some personnel and equipment were exchanged between vessels, and the U. S. C. G. C. *Northwind* made an ice reconnaissance to the south. A relatively open area was found and after a day and a half at the island the central group turned southward on December 31st. Extremely heavy ice pack was encountered on the second day south of Scott Island. Many huge bergs of barrier ice were interspersed among large, closely adjacent floes of thick bay ice. Virtually no progress was made for 5 days in this area—about 69° S. latitude. When the pack was finally cleared on December 14th, 10 days more than planned for had been expended in reaching the barrier.

The Bay of Whales was reached on the 15th and on that day and the next, small reconnaissance parties were sent into the bay on the ice breaker to estimate the landing possibilities and locate a base site. On the 17th unfavorable wind and ice conditions for entering the bay prevailed. At about this time it was thought that operations ashore would have to be curtailed. First, due to the width and heaviness of the ice pack—the most extreme conditions ever reported in this area—an early freeze-up of the Ross Sea appeared likely. Second, the flagship and the two cargo vessels had received varying degrees of damage in the passage through the ice. For these reasons a tentative departure date of 5 February was considered. Having arrived 10 days later than planned, and with departure by the end of the first week in February a possibility, there remained only 3 weeks for unloading, construction of the base, and shore based air operations. Ac-

* For expanded daily activities, see Chapter 13 "Combined Observers' Log."

cordingly, the construction of the metal airstrip was deleted from the plan, although short sections were to be laid for testing purposes. The R4D aircraft would then fly from plain ice shelf surface and would all be on skis throughout the operation.

The flagship entered the bay and tied up to the ice on January 22nd. Camp construction, including mess facilities was completed and the camp fully occupied on the 23rd of January. At this time work on the aviation facilities was accelerated, and by the 25th the Central Group was ready to receive the planes from the carrier. Weather conditions were not satisfactory at both the *Philippine Sea* and the Bay of Whales until the evening of 29 January, when the planes were called. The first two took off shortly before midnight and arrived at about 0500 hours on 30 January. The others arrived the same day around noon. The ice breaker, returning from its rendezvous with the *Philippine Sea*, reported much improved ice conditions in the Ross Sea. Accordingly, it was decided to finish unloading the ships, leave a 200-man air party ashore, escort the ships out through the pack, and send the ice breaker U. S. C. G. C. *Northwind* and U. S. S. *Burton Island* (the latter to arrive soon from the States) back to the bay for subsequent evacuation of the shore party. This plan had been considered previously and now appeared feasible due to improved conditions in the ice pack. March 1st was set as the latest date for final evacuation of the shore party aboard the ice breakers. The ships departed the Bay of Whales on 6 February.

In the meantime the R4D aircraft were modified by removal of the wheels to plain

ski (retractable) landing gear, loading plans were modified in accordance with final operational requirements, and aircrews made trial flights, checking out on the modified landing gear and JATO on plain snow surface. A trail party of seven men in two LVT's ("alligators") was prepared to journey southeast to approximately longitude 139° W. and latitude 82° S. to establish a weather observation point in support of the flights to be made. This party was out from 12 to 19 February, reaching the Rockefeller Mountains 90 miles from the base camp. At midnight on the 13th of February, the weather had cleared sufficiently to permit extended flying operations. Several days of clear weather followed, during which time most of the major flights were made. Up to 16 February most flights were made with JATO, but thereafter most were made unassisted due to improvement in the surface of the strip. The last major flight took off late on the 21st and returned the 22nd of February. Operations were discontinued with this flight and the camp closed on 23rd of February. The approximately 200 personnel left were evacuated on the U. S. S. *Burton Island*, and the majority of them were transferred to the flagship after passing through the ice pack.

On the return journey the vessels of the task force were routed both separately and in small groups so that various liberty ports were visited in Australia, New Zealand, and South America. The flagship passed through the Panama Canal on the 6th of April and arrived at Washington Navy Yard on 14th of April, completing a voyage of 22,000 miles.

ARMY INTEREST IN ANTARCTICA

SECTION I. Historical Comments

Navy Task Force 68 (Operation "NANOOK") sailed into northern waters in the summer of 1946. Basically this operation permitted a trial of ice breakers and other types of vessels maneuvering in the ice floes between Greenland and the Canadian archipelago. This operation served a useful purpose in addition to personnel training and tests of equipment. It transported supplies and aided in the building of a weather station at Thule, Greenland, and other weather bases would have been constructed in cooperation with the U. S. Weather Bureau, the Air Forces, and the Canadian government had not the speed of negotiations been so slow. At the end of the summer's operation (1946) in the north, it was clear to the Navy that the task of training and testing its equipment in ice-filled waters would require a long, patient period, because of the impending darkness and treacherous ice-filled seas. Task Force 68 ("NANOOK") returned to the United States in early fall 1946. The importance of continuing the "NANOOK" type operations was apparent to the Navy. It would be nearly 9 months before the Task Force could again return to the arctic waters safely. It therefore appeared desirable, in the meantime, to utilize these same ships and partially trained personnel to carry out a similar operation in other ice-filled areas. Antarctica, from December to March, would fit ideally into this program and permit this same Task Force to return again to Arctic Seas in July 1947.

It also appeared wise to the Navy to give its Task Force specific problems to carry out incidental to its normal polar problems and operations. These problems form an incentive which is both interesting, and at times sufficiently difficult to force the Task Force into conditions which give a battle-worthy test of equipment. Rear Admiral Richard E. Byrd conceived of a problem, namely exploration and scientific investigation of the world's least known continent, Antarctica. Because of his long experience and leadership in the field of Antarctic exploration, he was logically selected as a personal representative of Fleet Admiral Nimitz to serve as officer in charge of the project designated as "HIGHJUMP". The derivation of this name came from a whimsical change from a previous code name "POLE VAULT" which was somewhat too revealing at a time when the expedition's plans were in the classified state of preparation, thus implying at the start that flights would be made over the continent of Antarctica, including the South Pole itself. Task Force 68 continued under its previously organized pattern with Rear Admiral Richard H. Cruzen in command under the Commander in Chief of the Atlantic Fleet. Task Force 68 was informally discussed as a possible joint Army-Navy Task Force; however, no formal discussions concerning the Navy's Antarctic Operation were held with the War Department until after the Navy had decided to keep it strictly a Navy enterprise. The Navy invited six Army observers to join the expedition; how-

ever, they later agreed that this number of Army personnel was too small for so large an operation and the number was increased to a total of 16. Army assignments included three lieutenant colonels, two majors, two captains, one warrant officer, five enlisted personnel, and three civilian representatives of the War Department. Four of the enlisted men were Signal Corps photographers assigned to operational duties. Four of the

Army observers were men with previous Antarctic experience, whose experience had been gained on previous Byrd Expeditions. Dr. Siple of the War Department, associate of Admiral Byrd on all of his previous Antarctic Expeditions, was asked for by name to assist the expedition leaders in an advisory capacity and was further designated by the War Department as the Senior War Department representative.

SECTION II. Army Interest

The following points are listed as the principal reasons why the Army considered that it had a basic interest in the Navy's Antarctic Expedition:

A. National defense requires that the United States military forces must become proficient and capable of carrying out war operations in areas of high latitude, a situation in which the Army has had little or no experience. Antarctica is an unpopulated area with a wide diversity of conditions which would serve as a suitable proving ground with unlimited maneuvering areas. Seasonal timing permits the use of Antarctica for continuous operations when the Arctic area is in total darkness.

B. Conditions comparable to those on other icecaps are represented in Antarctica with comparatively easy access to the sea. The use of Antarctica is not complicated seriously by questions of sovereignty prohibiting research and operations.

C. There is so little known of Antarctica that incidental scientific investigations carried on by military forces are of a tremendous value toward unveiling the potentials of a continent largely opened up in recent years through the efforts of private United States citizens, even though no official claim to the

territory by the United States Government has ever been made. There is no proof, to date, whether there are or are not mineral resources in the Antarctic which would be of value to this Nation. With the exception of the discovery of the basic mineral coal, the continent has been so little prospected that it is reasonable to assume from the meager geological information gleaned that mineral deposits in economic quantities probably do exist there. Although the prime responsibility of determining the potential value of Antarctica is not necessarily a responsibility of the Armed Forces, they are the best equipped Government agency to perform such investigations at a minimum cost incidental to its program of training and research and development.

D. The isolation of Antarctica would permit greater opportunities for research and development and testing of long range military weapons without danger to population or interference with the sovereignty of other nations. It is also sufficiently isolated to permit reasonable security of operations, which might not be true of the Arctic. The principles involved in such operations could be worked out conveniently in the Antarctic in cooperation with nations

most closely approaching the Antarctic continent. These nations no doubt would welcome an international approach to the scientific unveiling of Antarctica.

E. Although the Arctic Sea is a basin enclosed by a ring of land masses with a fenced-in ice pack which is subjected to melting temperatures in the summer, the Antarctic continent, by contrast, is roughly circular, lying mostly within the Antarctic Circle and surrounded by a reef of ice pack which breaks up and flows outward in the summer until it is subjected to melting in warmer waters. The ice pack characteristics are therefore not identical, but are sufficiently similar to promote a study of maneuvering of ships and other vehicles through or over the surface which can conceivably figure strongly in the condition of Arctic warfare.

F. The average temperature for the Arctic region is considerably lower than for the Arctic region, so that equipment which will stand up under the winter conditions

of the Antarctic would generally be satisfactory for the coldest temperatures and conditions of the Arctic (actually the coldest surface temperatures recorded are those in Subarctic Siberia). The summer period in Antarctica rarely rises above freezing, which permits research work to be carried out at low temperatures under continuous conditions of daylight, thus permitting more rapid development than would be possible under the cold-dark conditions in the Arctic. Antarctica does not present summer Arctic conditions comparable to the tundra and muskeg country; however, in Alaska and through cooperation with Canada, wide areas of this nature are available for military investigation. Because of the difficult approach to the Arctic icefields, research and development of military methods of operations in these areas are greatly inhibited. The approach to Antarctica is much more open in this respect despite its greater distance from the United States.

ENGINEER OPERATIONS

SECTION I. Introduction

1. General.

This chapter is an account of Operation "Highjump" submitted by an observer from the Office of The Air Engineer who accompanied the expedition. It summarizes engineering operations and conditions encountered, presents problems of special interest to the Corps of Engineers, and makes recommendations.

a. The staff work and planning of Bureau of Yards and Docks was directed by Commander C. O. Reinhardt, U. S. N. (CEC). They had only 3 months prior to the sailing date to draw up all plans and specifications, fabricate special items, organize the Seabee detachment, and assemble matériel and personnel at the proper port of embarkation.

b. The Seabee unit was charged with all construction work, cargo handling and unloading, transportation, and messing while on the barrier ice. A 200-man temporary tent camp (fig. 3), two Quonset huts, three Wannigan Huts, three ski runways, and a PSP test strip were the main items constructed or assembled. Snow conditions and characteristics were studied in relationship to its supporting power. Even though the study of snow mechanics has hardly started, a considerable amount was learned and one would be safe in stating that the loose granulated snow of the Antarctic can be compacted within 1 month's time to carry the load of a C-47 on wheels without any wearing surface, such as PSP, on the runway.

c. It was learned on the expedition that there are three main groups of items or

subjects which should be given considerable thought and study—they are housing, transportation and construction equipment, and snow compaction. If the Army is contemplating future operations in regions similar to the Antarctic, further development of these subjects is a necessity if the operations are to be successful.

2. Staff Work and Planning

It was not until the first of September 1946 that the Staff Officer from Bureau of Yards and Docks was able to start organizing available data and planning for Operation "Highjump". About the middle of September the planning got underway on a large scale and in less than 4 weeks drawings and/or specifications were ready to leave Washington, D. C. This meant that all equipment, other than standard items, had to be fabricated and brought to the ship's side for loading in less than 6 weeks. The majority of this work was performed by the Advanced Base Depot, Construction Battalion Training Center, Port Hueneme, California. Other items such as the "Go-devil" sleds were manufactured by private concerns. Two hundred and fifty thousand dollars was allotted by Bureau of Yards and Docks for all their supplies, labor, materials, prefabrication, etc. The rest of their total cost, which was approximately five times that large, was required to come from surplus property. At the time when the planning commenced there were no organized construction battalions available. The first of

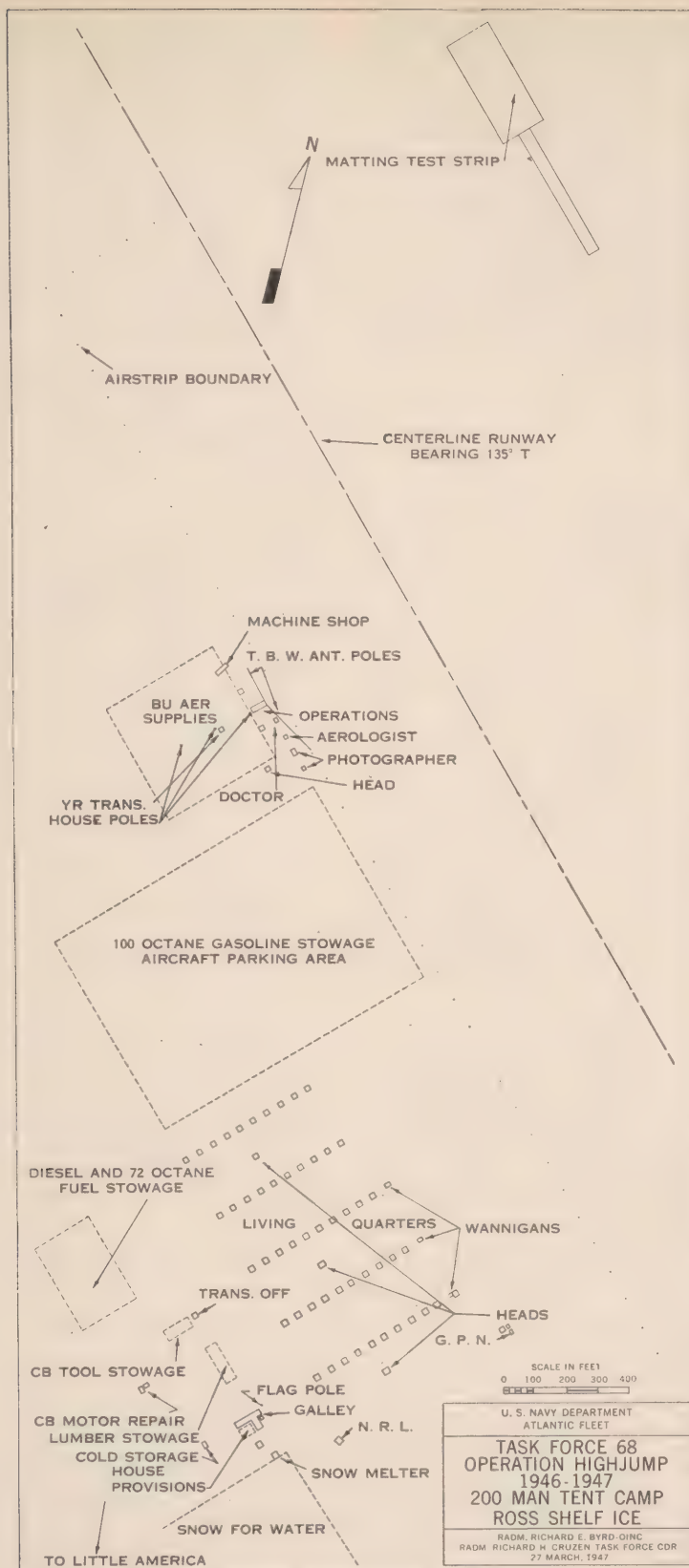


Figure 3. Map of 200-man tent camp on Ross Shelf Ice.

November two officers, one warrant officer, and approximately 175 men were ordered to the unit at Port Hueneme, California. Of the entire enlisted personnel only about 25 or 30 were Seabee personnel; the rest came from general service organizations and without construction knowledge other than that which they would normally receive while aboard ship. The month of November was spent organizing the unit, training, drawing clothing, etc.

3. Responsibilities.

The senior Civil Engineer Corps Officer (Commander C. O. Reinhardt) was to be responsible, subject to the military control of the senior officer present afloat, for all construction ashore and the discharge of cargo and its transportation from ship's side to the base camp. Officers charged with the command and operation of facilities ashore were to be responsible for advising Commander Reinhardt of their requirements and were to be available for consultation during the erection of facilities under their jurisdiction. He was to arrange for additional personnel from ships present through the Senior Officer Present afloat.

a. Commander P. D. Davis was to supervise all construction ashore and expedite the erection of facilities in accordance with the established priority. He was to be responsible for the distribution of personnel and equipment assigned to construction and for supervision of construction. He was to be the Officer in Charge of the Construction Battalion Detachment and was to have the following Officers under his supervision: Lt. V. B. Peller (CEC) U. S. N., Capt. V. D. Boyd, U. S. M. C. (while working with construction equipment and transportation), Ens. C. B. Mallory, Chief Warrant Officer Ulan, and any other officers who might be attached for construction work, cargo handling, or transportation within the camp area.

b. Lt. V. B. Peller was to coordinate the unloading of cargo and its movement to a position of safety at the foot of the barrier. He was to be responsible for discharging cargo at the maximum safe rate and for assuring that cargo would be discharged in accordance with the established priority.

c. Capt. V. D. Boyd, U. S. M. C., was to report to Comdr. C. O. Reinhardt for administrative direction and was to be responsible for the operation of all equipment assigned, and for the movement of supplies and personnel from the ship's side to the base camp.

d. After the first stages of unloading cargo, Ens. C. B. Mallory and 12 men were to have the sole assignment of performing such tests as those which would not normally be run during construction. These men are not included in the Seabee unit, but were to work only for Bureau of Yards and Docks.

e. Chief Warrant Officer Ulan, who has had considerable experience with construction equipment, was to be the heavy equipment and transportation expert.

f. Other officers were to be designated to supervise the storage of materials at the base camp, to assist in controlling the movement of supplies from the barrier to the base camp, and to assist in that construction which was deemed necessary. These officers were to be taken from the observer group and were to be those who were most interested in this phase of the expedition.

4. Cargo Discharge.

Immediately upon arrival the discharge of cargo was to have the highest priority. All personnel not required for the security of the Task Force were to be assigned to assist in the discharging of cargo and later in the construction of the base camp. All construction and cargo handling was to be on a 24-hour basis. Personnel required for construction were to be released from discharging

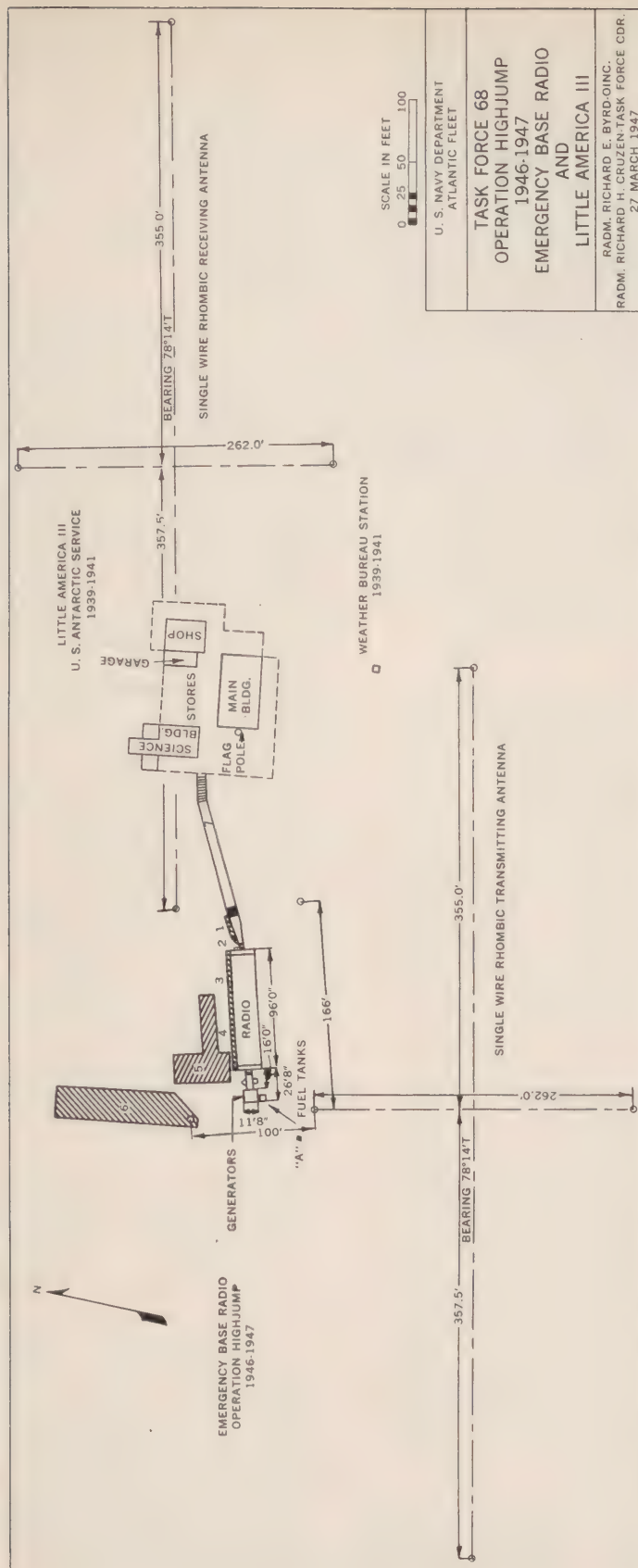


Figure 4. Emergency base radio and Little America III.



Figure 5. Bay of Whales area looking at about 135° with camp area in background. Mess hall and motor pool to the right of tents. Base operations down and a little to left of tents. Beginning of PSP test strip above the far ship. (24 Jan 47)

cargo as soon as possible. After cargo priorities 1, 2, and 3 had been discharged men were to be released in such numbers and skills as to enable the construction of facilities to keep pace with the rate of discharge of materials. Skilled personnel other than Seabees were to be released from both cargo handling and construction as soon as possible after facilities were available for any projected operation.

5. Cargo Discharge Priorities.

Each ship was loaded so that it could be discharged in accordance with the established priority for equipment and materials ashore. All the cargo in the first six priorities was loaded on the U. S. S. *Yancey* with priorities seven through eleven on the U. S. S. *Merrick*.

a. Priority One. Transportation and cargo handling materials and equipment (tractors, fork lifts, sleds, lashing, cargo slings, tarpaulins, trail markers, slings, etc.).

Note. As soon as possible after the first sleds were ashore, an emergency subsistence kit for 25 men for

5 days, including tents, rations, and fuel, was to be unloaded and a cache established in a safe place.

b. Priority Two. Ten days' supply of diesel fuel and operating supplies for transportation and construction equipment.

c. Priority Three. Communication equipment for local control of unloading and construction.

d. Priority Four. Materials required for the erection of a 300-man temporary tent camp, including 10 days' supply of fuel for heating and cooking, 10 days' rations for 300 men, and medical supplies.

e. Priority Five. Materials for construction of air operating facilities, including pierced plank, one Quonset hut, radio, GCA, GPM2, 15-kw generator, aviation field lights, shop and maintenance equipment.

f. Priority Six. Five days' supply of aviation gasoline and operating supplies for aircraft, gasoline truck, oil truck, fire fighting equipment.

g. Priority Seven. Initial supplies of diesel oil, aviation gasoline, rations, and other operating supplies were to be maintained at a constant level by daily replacement.

h. Priority Eight. Daily replacement of shore stores of aviation gasoline, diesel fuel oil, and other operating supplies to maintain a safe reserve ashore.

i. Priority Nine. Material and equipment required to erect a 35-man emergency winter hut camp.

Note. Base radio and communication equipment to be discharged as soon as radio hut was erected.

j. Priority Ten. Special gear submitted for test.

k. Priority Eleven. Rations, fuel, and operating supplies for 35-man emergency hut camp for 14 months to be discharged only in the event that it was necessary to occupy that camp.

l. Priority Twelve. Duplicate aviation operating supplies.

6. Construction Priorities.

The following priorities were assigned to construction with the assumption that the two AKA's and the AGC would be moored in the Bay of Whales from early January until all operations had been completed, first of March, and that communications and Flight Control would be handled by the U. S. S. *Mount Olympus*.

a. Priority One. Construction of an access roadway from the ship's side to a place of safety on top of the barrier, rigging to move cargo sleds from the ship to the top of the barrier, establishing an emergency subsistence facility on top of the barrier, and installing communications for local control of unloading and construction.

b. Priority Two. Breaking a trail to the base camp.

c. Priority Three. Erection of 300-man temporary tent camp. The facilities actually installed were to be sufficient to accommodate personnel actually ashore and were to be expanded to the ultimate 300-man camp as it became necessary to quarter additional personnel ashore.

d. Priority Four. Installation of air operation facilities.

(1) Quonset hut for service facilities.

(2) Radio equipment.

(3) Pierced plank landing mat 150 by 5,000 feet, with parking area, fuel dump, and runway lights.

e. Priority Five. Erection of 35-man emergency winter hut camp.

(1) Radio hut with additional insulation.

(2) Power plant.

(3) Radio antenna.

(4) Galley and mess.

(5) Quarters.

(6) Connecting structures.

(7) Additional insulation in huts.

f. Priority Six. Special facilities for testing equipment under cold weather conditions.

g. Of the items listed above the most

difficult to be constructed was the runway. It was planned to first construct a parking area to determine the best method to use during this operation. Such materials and special designed equipment as calcium chloride, snow drags, snow rollers, oil burners under a hood (snow melter), and dark objects (PSP) laid on the surface, were to be experimented with. After the most feasible method had been found, and if time and personnel permitted, a 150 by 5,000 foot runway was to be constructed to accommodate plane wheel loads of at least 60 pounds per square inch on the tire contact area.

7. Collection of Data.

A large part of the technical and scientific information which would normally be obtained by an engineering unit should be gathered from field experience of this unit in the construction operation. Additional tests which the Bureau of Yards and Docks wished to run were as follows:

a. Field Loading Test. Purpose—To estimate the plane wheel load capacity of the "pavement" which is understood to be either compacted snow or compacted snow covered with steel mat.

b. Snow Penetration Test. Purpose—To determine the supporting power of the compacted snow.

c. Density in Place Test of Compacted Snow. Purpose—To determine the density of compacted snow at different depths.

d. Field Shearing Tests. Purpose—To determine the in-place shearing resistance of compacted snow.

e. Tests on Ice and Frozen Materials. Purpose—To determine the bending, shear, and compression characteristics of compacted snow and/or ice.

f. Tests on Dry Chemical Fire Extinguishers. Purpose—To determine suitability of extinguishers for use in extremely low temperatures.

g. *Test on "Little Giant Tractor Saw."* Purpose—To determine ability of subject saws to cut natural ice and snow into blocks.

8. Operations.

a. Due to the heavy ice pack the ships were not able to get through and start unloading until 18 January. The two AKA's and the AGC departed from the Bay of Whales on 6 February which resulted in their being available for unloading and assisting the expedition less than 3 weeks instead of the previously planned 8 or 9 weeks. This necessitated the changing of unloading priorities to meet changed construction priorities which placed the construction of the 150- by 5,000-foot pierced steel plank runway last instead of immediately after the construction of the tent camp. After inspection of Little America III, it was decided to enlarge and improve it instead of constructing an entirely new 35-man emergency winter camp.

b. The operation plans for both loading and discharge of cargo, and construction of the base showed a considerable amount of staff work and gathering of information. They were well prepared, presented to subordinates so that they were easily followed, and flexible enough to cope with the over-all change in plans of the Central Group.

c. The general construction plans, even though priorities were changed, were followed throughout. Until such time as the ships left, construction work and unloading continued on a 24-hour basis, with the men quartering and messing on the ships which were moored in the Bay. Until 6 February the actual working hours were from about 0700 to 1730, with an hour and a half for the noonday meal for the day shift. The actual working hours for the night shift were from about 1830 to 0530 the following day with 1½ hours for the midshift meal. The evening meal on 23 January was the first to

be served in the camp and from this time on the men working in or near the camp area ate the midshift meal on the ice.

9. Personnel.

The Bureau of Yards and Docks was represented by an excellent team of officers who planned and supervised their work. The staff was headed by an officer who was efficient and definitely gifted in that type of work and in gathering information from experiments which will be the basis for Antarctic construction for years to come. The other was especially qualified and efficient in the details of field construction and the handling of personnel. The efficiency with which the project was carried out reflects the cooperation between those responsible for its planning and those charged with its execution. Cdr. Davis was in charge of the day shift with Lt. Col. Partridge (U. S. M. C. observer) assisting in caching of cargo and construction of facilities, and Lt. Peeler and Ens. Mallory assisting in unloading cargo and transportation. Cdr. Reinhardt was in charge of the so-called night shift with Major Holcombe (U. S. A. observer) assisting in caching of cargo and construction of facilities, and Captain Boyd, U. S. M. C., and Chief W. O. Ulan assisting in unloading cargo and transportation. From time to time Capt. Wiener and other officers helped for short periods.

a. Of the approximately 175 enlisted men, 15 held a chief's (master sergeant) rating, one was in the motor pool, one similar to the 1st sergeant, one was master-at-arms, and the other 12 were on camp construction. The approximate distribution of personnel, including chiefs, was:

Overhead	3
Cooks and KP's	24
Repairmen and operators	35
Camp detail	106

The camp detail personnel, plus additional personnel from the ships, did all construction work on the tent camp, Quonset and Wannigan huts, handling of cargo from the ship's side up the barrier, and until it was properly cached, construction of the 35-man emergency winter camp, construction of the ski runway, and the test PSP runway.

b. When the ships departed from the Bay of Whales on 6 February, the following enlisted personnel were left on the ice:

Cooks and KP's (24 hrs)	18
Repairmen and operators (24 hrs)	12

Camp detail 16

This camp detail was necessary to finish construction of connecting tunnels, etc., at the 35-man emergency camp and maintain the 200-man tent camp.

c. Even though the majority of the Seabee personnel were unskilled in construction work of this type, their efficiency was very high considering climatic conditions. It is believed this was due to their high morale which was maintained by excellent leadership and abundance of good and well prepared rations, 29 percent over and above the normal Navy ration.

SECTION II. Construction Equipment

1. Performance of Equipment.

The main items of equipment which were used lived up to expectations even though they are by no means the answer for Antarctic work or transportation. They were D-6 Caterpillar tractors, TD-9 International fork lift tractors, "Go-devil" sleds, QM 1-ton sleds, Weasels (Cargo Carrier—M29C), the wooden snow drag, and the pontoon snow drag. The efficiency of these items depended upon the hardness and supporting power of the snow, which was governed by the temperature and climatic conditions in that the higher the temperature the softer the snow became resulting in low efficiency, whereas the lower the temperature the harder the snow became, thus raising the efficiency of track-laying vehicles. Wheeled vehicles were out of the question and considered not satisfactory for normal Antarctic use.

2. Conditions Encountered.

The vehicles on this operation encountered pressure ridges, shear cracks, crevasses up to

3 feet across, slopes or grades up to 20 degrees, surfaces from those that would support only a few pounds (2 to 4) per square inch to sea ice several years old, temperatures from 30° F. to — 22° F., and winds up to 38 knots.

3. Tractor, D-6 Caterpillar.

a. This tractor (fig. 6) was modified with the following: hardwood track extensions which decreased its bearing pressure from around 8 to about 5 pounds per square inch; winterized cabs which protected the operators from low temperatures and strong winds; canvas winterized hoods for engine protection; and track support blocks which replaced the support rollers. The extensions lived up to expectations, even though they required replacing frequently. A number would break off at the edge of the grouser plates. Others would split, this being caused by the bending of the C washer which was used in securing the extensions. The cabs caused no noticeable trouble, but in time

would have shown wear from vibration. The canvas hood shrank, becoming difficult to fasten properly. The track support blocks functioned as expected without giving any trouble.

b. The tractor as manufactured gave very little trouble and only minor adjustments were necessary. All tractors were equipped with Hyster winches which proved very useful. All the D-6's were used for the first 2 weeks of the operation. All but three with extensions and one with a dozer blade were loaded back aboard ship on 5 February so that they could be returned to the States. The efficiency of this tractor was reduced considerably during high temperatures (20° to 30° F.) and soft névé. Later on when the temperature dropped and the surface would support more, the tractors with extensions functioned better. The tractors without ex-

tensions operated satisfactorily on the bay ice even though at times it was hard to obtain a foothold; on the undisturbed snow at high temperature, the tractor without extensions was useless, but did manage to travel across undisturbed snow when the temperature was down to about -15° F. The tractor seemed to hold its footing better while traveling in reverse, i. e., while pulling heavy loads in a forward gear, the rear of the tractor often buried itself; whereas when pulling backward the tendency was not so great. All tractors either worked or idled 24 hours a day except for a period each day when they were being serviced. By the end of the 5-week period on the ice, the tractor hour meters averaged slightly over 500 hours.

4. Tractor, D-7 Caterpillar.

Only one of these was taken on the expedition and it was loaded back aboard after 2 weeks to return to the States. While in the Antarctic, it was used only as an anchor at the top of the barrier as explained in section III. No observations were made, but it is believed it would have performed very similarly to the D-6 tractor.

5. Carrier, Cargo, M-29 (Weasel).

This item was used without modification and proved very useful in that it was the only light piece of transportation on the ice with the exception of dog teams. It was used mainly for communications and to transport personnel. Occasionally small quantities of supplies were moved when it became necessary to expedite their movement. The two main difficulties that arose in the Antarctic that would not arise in another theatre of operations were—

a. Track stiffness.

b. The difficulty encountered while entering, operating, or leaving the vehicle.

After the vehicle had stood for some time it was difficult to start it moving smoothly



Figure 6. Winterized D-6 caterpillar tractor.

even though the engine had been idling. It seemed as though a heavy load was tied on behind and the engine was lacking power. After the vehicle had been traveling for some time it operated much more efficiently. It is believed this was caused by the rubber tracks becoming cold and stiff while standing and then loosening up as they were used. While in the Antarctic one is required to wear considerable clothing in order to remain comfortable. This makes it difficult to climb in and out of the amphibious Weasel and extremely difficult to operate with the close quarters around the steering brake levers, clutch, and accelerator.

6. Forklift (Hughes-Keeman Model TD-9-6C).

Modifications for the two International tractor forklifts were the same as for the D-6 tractors: hardwood track extensions, winterized cabs, winterized engine hood, and track support blocks. The modifications acted the same as those for the D-6 tractor. The main operational difficulty was met as the machine tried to turn or back around while moving cargo from the sleds to the cache,



Figure 7. Escape hatch in winterized cab, D-7 caterpillar tractor.

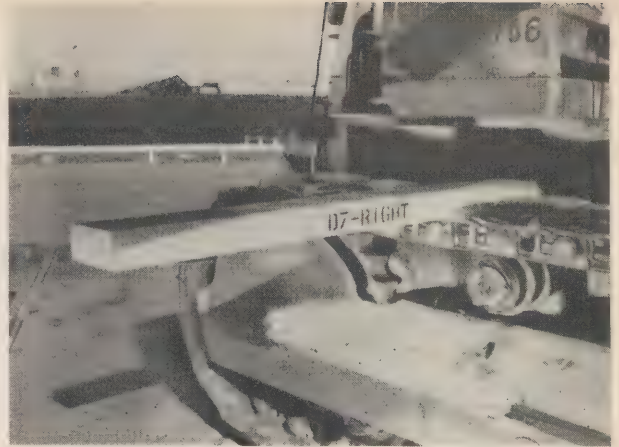


Figure 8. Track extension on D-7 caterpillar tractor.

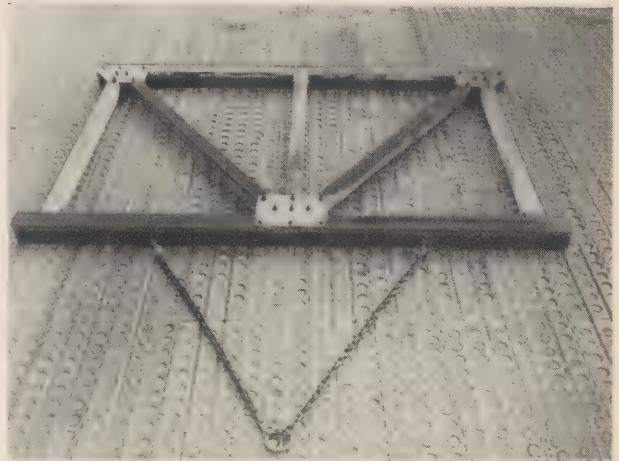


Figure 9. Wooden snow drag.

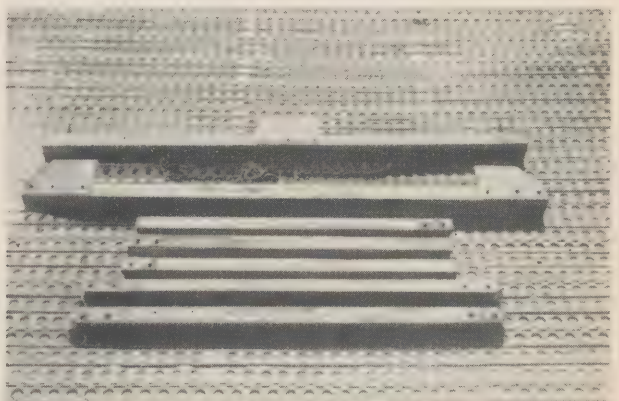


Figure 10. Package shot (disassembled) wooden snow drag.

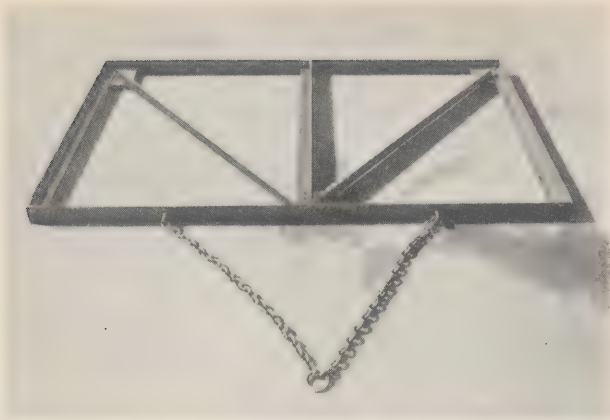


Figure 11. Steel snow drag (not used).

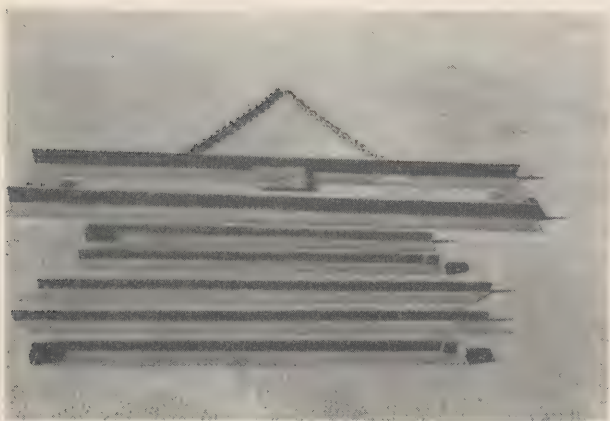


Figure 12. Package shot (disassembled) steel snow drag.



Figure 13. Package shot (disassembled) pontoon snow drag.

which would be only a few feet. The track under the driving sprockets would often become buried, requiring help to get out. The operator had to be extremely careful to avoid disturbing the snow surface. Cargo handling equipment is extremely valuable in regions similar to those encountered.

7. Go-Devil Sleds.

This is a specially modified item of which 20 were manufactured by the Michler Sleigh and Wagon Company, for Operation "High-jump". It was the main cargo sled and was used throughout the stay on the ice. (See sec. III.) Even though it proved satisfactory, more changes can be made in its design. The over-all structure seems to be a little heavy for its pay load. The runner contact area is small, causing the sleds, when loaded, to sink with snow piling up in front of the entire sled. The undercarriage is not designed to keep the sled from becoming buried in soft snow as is the toboggan undercarriage of the QM 1-ton sled. The side board recesses which were above the floor level of the sled made it difficult to secure large and awkward-shaped cargo and boxes.

8. QM 1-Ton Sled.

This sled was very satisfactory and when used in the manner for which it was designed gave little or no trouble. It is believed that a large runner contact area would help in Antarctic use.

9. Snow Drags.

Two types of drags were tested: the wooden snow drag, and the pontoon snow drag. The purpose of the wooden drag was to level the sastrugi, which it did very satisfactorily, even though a lighter drag could have been used to better advantage on soft, undisturbed, snow. As the snow became compacted it is possible that an even heavier one could have been used. The pontoon

drag was used to iron out the snow and leave a smooth finish which definitely expedited the construction of the three ski runways. The results with the pontoon drag are very similar to those with a steel wheeled roller on earth in that the top inch or two is well compacted with a "burnish" finish, leaving the snow farther down relatively undisturbed.

10. Grader, MTZ, with 12-Foot Mold Board (Adams).

This machine was not unloaded because it was believed it could not have been towed to the camp site. If runways are to be constructed in areas similar to Antarctica some type of grading machine will be essential.

11. Snow Surface Heater.

This heater was unloaded, but due to circumstances beyond control, was not tested.

12. Other Items.

a. The "Cle-track tractor" as used by the Air Corps to tow planes was taken on the expedition, but proved unsatisfactory due to



Figure 15. Snow surface heater with extra burners.

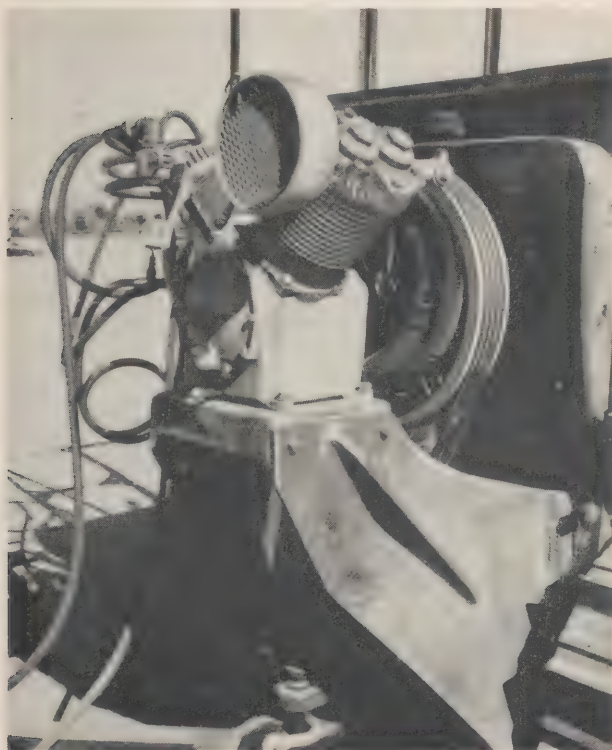


Figure 14. Compressor mounted (D-6 caterpillar tractor) for snow surface heater (40 cfm at 25 lb./sq. in.).



Figure 16. Unloading cargo from ship direct onto "Go-devil" sled.

the rubber tracks which caused the same trouble as did the rubber tracks on the "Weasel", plus the fact that they would not support the hard wooden track extensions.

b. Wheeled vehicles such as truck $\frac{1}{4}$ -, $2\frac{1}{2}$ -,

and 4-ton were unloaded, but are definitely not suited to the snow surface which will support only a few pounds per square inch. All except a couple of Jeeps were reloaded aboard ships and returned to the States.

SECTION III. Cargo Handling and Unloading

1. Equipment.

a. Standard stevedore equipment was used to discharge the cargo from the ships onto the bay ice which floated about 18 inches to 2 feet above the water. This operation was carried on by the ships' personnel and with priorities as requested by Commander Reinhardt from day to day or whenever it became necessary.

b. The "Go-devil" sled was used almost throughout for transporting supplies and equipment to the base camp. As D-6 tractors would return to within a hundred feet of the ship's side with two or three sleds, a towline from the ship would pull a sled alongside, this being practiced so as to eliminate any danger of excess weight cracking the bay ice. The cargo was loaded direct from the ships onto the sleds and a tractor would tow them one at a time about 1 mile to the foot of the barrier. The sleds were then hooked to a towline and pulled up the barrier slope by a tractor hauling on a cable, the cable running through snatch blocks at the top of the barrier. The D-7 tractor with blade was used as an anchor. From this point the sleds were pulled to the proper cache by D-6 tractor with track extensions.

2. Bridges.

a. It was necessary to build two bridges between the ships and the barrier. One crossed a pressure ridge while the other

crossed a sheer crack in which the two sides were moving in opposite directions at a rate of slightly over 4 feet per day.

b. These two bridges were more or less of a standard type, the same as would span any deep crack in soft dirt. The bridges, being one vehicle wide, were constructed by placing 8- by 8-inch sills in one case and 40-foot piling in another, across the ridge or crack. They were then tied together with



Figure 17. Unloading lumber from ship directly onto "Go-devil" sled (lumber to be used to construct bridge across cracks in bay ice). Note tractor staying away from ship's side in order to prevent danger of cracking edges of ice.

cable with approximately 1-foot spaces between each sill. Three-inch flooring was well spiked, with treadways of 1-inch dunnage going on top. PSP was placed on one of the bridges but soon became bent, which necessitated its removal. These bridges served their purpose and lasted until the ships departed from the Bay. Later on, about the last of February, when the time came to evacuate the camp, the bridge which crossed the sheer crack required replacing. During the time of our stay another crack developed about two-thirds up the barrier slope, but did not cause any great difficulty. Only one footbridge and one weasel bridge were necessary.

3. Caches.

The three main caches were:

a. Near base operations which included all aircraft parts, equipment, fuel, etc.

b. Near the mess hall and motor pool which included all Seabee supplies, equipment and fuel, housekeeping equipment, rations, etc.

c. At Little America III which included rations, fuel, some construction material and those other supplies which were to complete the 35-man emergency camp.

4. Cargo Segregation.

Due to the large amount of cargo which arrived at the port late and was loaded aboard the ships during the last few days before leaving the States, all cargo was not stowed as set up in the Naval Operation Plan No. 2-46, which resulted in the segregation of supplies on the ice, causing somewhat of a problem. This problem was



Figure 18. Tamping snow on a bridge with a tractor.



Figure 19. Bridge crossing crack in bay ice (PSP was put on top of one of the two bridges as wearing surface).



Figure 20. Tractor without track extensions towing "Go-devil" sled loaded with supplies across bridge on bay ice. Note bending of PSP.



Figure 21. Damaged PSP on bridge which crossed crack in bay ice was later removed.



Figure 22. Footbridge and weasel bridge crossing crevasse which developed two-thirds of the way up barrier slope.



Figure 23. Snowdrifts at aviation gasoline dump after a blizzard.



Figure 24. Removing supplies from cache which had been covered during a blizzard.



Figure 25. Aviation gasoline tank on skis was used to refuel R4D's (D-47's).

aggravated because of improper or inconspicuous markings and the change in plans which required the ships to leave the Bay of Whales earlier than originally planned. A considerable number of man-hours was spent restacking boxes and looking through dumps



Figure 26. Bay of Whales Area looking at about 315° . Mess hall and motor pool to left of tents; base operations beyond and to right of tents. Roadway leading from tent area to the left leads to Little America III (35-man winter emergency camp).

for missing items. Occasionally a sled would arrive with some of its cargo going to each of the three dumps, resulting in "tying up" sleds which were required to transport more supplies.

a. All fuel, 100-octane gasoline, 72-octane

unleaded gasoline, aviation oil, motor oil, Diesel fuel, and kerosene were shipped in 55-gallon drums, which were clearly marked. The aviation fuel and oil was cached half-way between base operations and the tent camp in piles of about 100 drums each with

the piles being about 100 feet on center. The other main fuel cache, which was southwest of the tent camp and near the motor pool, was stored in the same manner.

b. The smaller planes, OY (L-5) and JA (Norseman), taxied in between the piles for refueling. The gas for the R4D's (C-47) was pumped from the drums into a tank sled

and pulled by a D-6 tractor to the planes for refueling.

c. All fuels were standard, the same as would be used on any cold weather operation within the continental United States, except the Diesel fuel which had a -40° F. pour point. Specifications USA 2-102, C AM 3, NGS X-4205.

SECTION IV. Buildings and Shelters

1. Temporary Tent Camp.

The first construction to take place on the barrier was the erection of a 200-man temporary tent camp (figs. 27, 28, and 29). Fifty pyramidal tents were erected to house personnel, four officers or five men per tent, and were arranged in five rows, tents being approximately 40 feet on center and the rows 200 feet apart with the kitchen and mess hall being about 300 feet on the extension of the first row. Eleven other tents were erected around camp mostly at base operations and were of the same type construction.

a. At the time the tent camp was being erected the temperature was only slightly below freezing and the surface would hardly support the weight of a man on foot. Quite often an individual would sink down to his ankles, and if he stepped into an already disturbed area he would often go in up to his knees. For this reason, care was taken not to disturb that area which the tent would occupy.

b. Eighteen pieces of 2- by 6-inch lumber 12 feet long came bundled together so that one bundle would furnish the sills for one tent. The 2- by 6-inch pieces were scabbed together and placed flat on the snow so that there were nine 24-foot members lying approximately 2 feet on center. After the first few tents this was changed to five sills lying 4 feet on center which were scabbed

together with the remaining 2- by 6-inch pieces instead of 1-inch lumber.

c. All floors had been prefabricated into 4- by 8-foot sections and bound together so that one bundle made a complete floor.



Figure 27. Tent camp area looking at about 315° . Latrines are between tent rows; GPN lower right. Mess hall area to left of first row of tents; above mess hall area is Seabee cache area. Just beyond tents is aviation gas dump. In upper right corner of picture is base operations area and aviation supply cache.



Figure 28. Tent camp area looking east. Motor pool, gasoline, and Diesel dump in foreground.

The bundles for the 17- by 20-foot wall tents were the only ones that varied in number of floor sections in that they contained ten instead of the standard eight. These floor sections were placed so that the joists supporting the plywood flooring ran perpendicular to the sills and were 2 feet on center. Each section of flooring contained a loose 2- by 4-inch piece, 8 feet long which was nailed on to the joist so that it extended out 4 feet beyond the floor's edge for outriggers, furnishing an anchor for the tent ropes. The tent was erected in the normal fashion with a tent stove being installed and ready for use. As is normal in any tent camp,

inside frames, plywood doors of various types, etc., were added by the occupants. Some went further and put in ceilings and inside walls; anything to help as insulation and to make home more comfortable.

d. The tent camp was adequate in this case and would be for any other operation of this kind, provided it is to be only for a very short period and will not encounter temperatures lower than from 0° F. to -10° F.

2. Kitchen and Mess Hall.

a. The kitchen and mess hall (fig. 32) were made up of three 17- by 20-foot wall tents, one pyramidal tent, and one 16- by 50-foot

hospital tent all tied together. They were constructed in the same manner as were the living quarters with the exception that inside framework and doors were constructed by Seabee personnel.

b. As one entered the pyramidal tent he picked up his metal tray and silverware, passed through the chow line at the far end of the tent where the field ranges were arranged in a line perpendicular to the line



Figure 29. Officers' row. Note snowdrifts which have blown in between each tent; note also that each tent has a different type entrance which was built by occupants.



Figure 30. Floor panel bundles (one bundle was required per pyramidal tent).



Figure 31. Assembling pyramidal tent floors. Note piles in background. Each is the required material for one pyramidal tent.



Figure 32. Erecting mess hall and kitchen tents.



Figure 33. Detail refueling tent camp. Average pyramidal tent used 8.3 gallons per day.

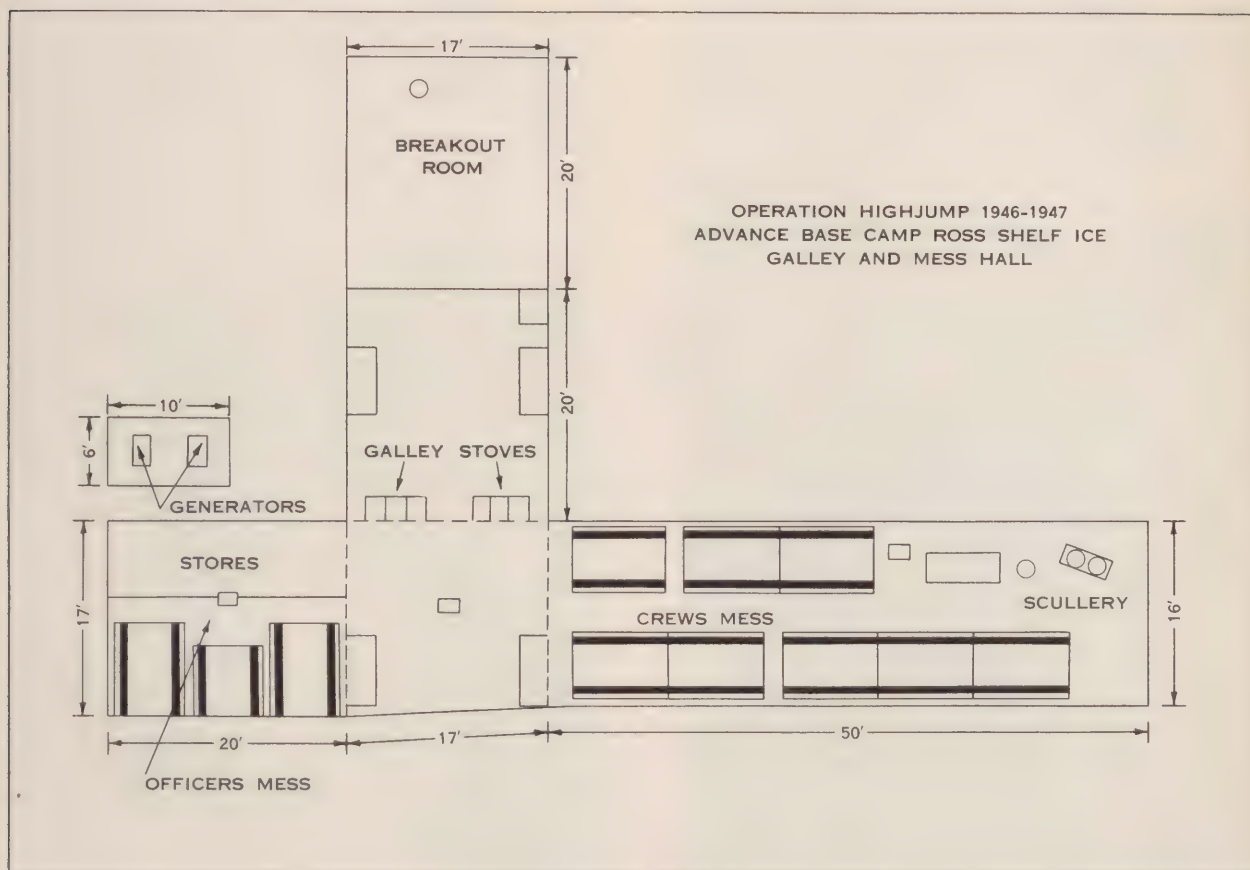


Figure 34. Advance base camp, Ross Shelf Ice: galley and mess hall.

of entry, and on to the mess hall (men to the hospital tent on right, officers to the wall tent on the left). The actual kitchen reached from the back of the pyramidal tent (chow

line) to the end of the first wall tent. The second wall tent, still farther back, sheltered a store or break-out room. About one-third of the officers' wall tent was used as a

range storage and repair room. The mess gear washing was done at the far end of the hospital tent. This construction and arrangement worked very satisfactorily.



Figure 35. Mess hall and kitchen.



Figure 36. Garbage pit in snow which was at far end of mess hall. All kitchen waste was dumped in this hole, which grew deeper as it was used.

3. Headquarters Building.

There was really no headquarters building for the base camp. The Seabees used a tool tent at first and later moved their tools, etc., to the motor pool tent. The standard Quonset hut (fig. 41) at base operations, which was erected with a little more difficulty than were the tents, carried on more administrative work in one of its corners than did the rest of the whole camp.

4. Quonset Huts.

a. The huts were also erected while temperatures were slightly less than freezing, which caused quite a problem in leveling and squaring the floor frame. In order to aid in this operation, 1-inch dunnage was first laid on about 2-foot centers and perpendicular to the 2- by 10-inch and 4- by 4-inch sills which went on top. After the floor frame (fig. 42)



Figure 37. Digging hole for frozen food storage. Note snow being sawed into blocks for easier handling.



Figure 38. Framework for frozen food storage house.

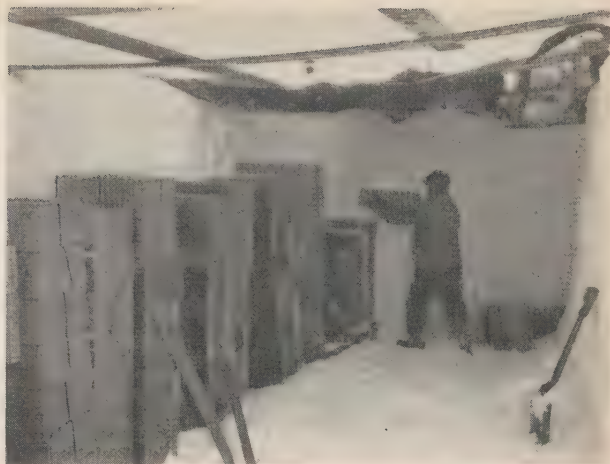


Figure 39. Storing food in frozen food storage house.



Figure 40. Tarpaulin being pulled over framework of frozen food storage house. It was weighted down by putting dunnage and snow blocks on top.



Figure 41. Quonset hut floor at base operations just after a blizzard.

had been assembled, it was trued by the use of an engineer's chain and level, which took about four times as long as it would have under normal conditions. The other major difficulty in the erection was that the small nuts, bolts, and plates required bare hands to put into place. With the exception of these two difficulties, the latter hardly being an exception, the work progressed the same as it would have during any operation with the same temperature and wind conditions. The only difference between this hut and the standard Quonset hut is that there were

two $\frac{3}{4}$ -inch plywood floors which were separated by 1-inch dunnage furring. Shortly after the hut had been completed a blizzard arose causing snow to blow in at the joint between the bulkhead and the corrugated sheet metal, leaving the snow lodged between the inner masonite wall and the outer corrugated sheets. Later heat from the inside of the building melted the snow causing the masonite to become wet and fall out of place. This incident could hardly be called a fault in the building design but should be credited to faulty construction.



Figure 42. Floor frame assembly for Quonset hut. Note near left corner metal sills are resting on 4- by 4-inch members, which are resting on 2- by 10-inch pieces, which are resting on and perpendicular to floating dunnage foundation.



Figure 43. Quonset hut at base operations under construction. Note inside wall of Quonset hut at far end, outside corrugated sheets on left end and insulation which goes between the two surfaces being applied in the middle of the building.



Figure 44. Looking southwest. Excavation for connecting tunnel leading from double Quonset hut in background to Little America III, which is beneath the photographer who took the picture.

b. A double hut 20 by 96 feet was erected at Little America III in very much the same fashion and encountering the same difficulties. This hut enlarged the old base so as to make it adequate if it became necessary to leave a party through the winter night. It had the following additions over and above a standard Quonset:

- (1) Double bulkheads approximately 4 feet apart.

- (2) Double "Kimal" insulation between inner and outer walls.

- (3) Double floors, 3 inches apart, and so constructed that air circulated between them.

- (4) Waterproof paper and $\frac{3}{4}$ -inch Celotex which was inside and separated from the metal outside wall by a dead air space.

Once erected, it is suitable for Antarctic and Arctic use, but the difficulty encountered in constructing it warrants a different design.

5. Wannigan Huts.

Three prefabricated Wannigan huts having about 6-inch walls and inside dimensions of approximately 7 by 14 by 7 feet high with a door at one end, were taken on the expedition



Figure 45. Southwest end of double Quonset hut at Little America III (35-man winter camp) showing escape hatch, short connecting tunnel, and generator house on right end.



Figure 46. Inside of Quonset hut at Little America III. Note gap in floor on right side so that warm air can circulate to the left and come up through cracks in center of floor (cracks not visible).

to be used as sled houses to transport men to and from the airstrip so they might have a place to warm themselves while drinking their midshift coffee. Instead, the six sections—two ends, two sides, one sled bottom, and a top—were bolted together without much difficulty and used as quarters for the three ranking officers. This type of structure is suitable for Antarctic and Arctic use.

6. Construction Time Required.

The construction of the 200-man tent camp required approximately 1,200 man-hours, the single Quonset hut at base operations required approximately 600 man-hours; and the double Quonset at Little America III required approximately 1,400 man-hours.

SECTION V. Utilities

1. Water.

Water requirements for the kitchen and mess hall were furnished by snow melters. Water for personal cleanliness, washing of clothes, etc., was obtained by the individuals concerned by using a bucket or large can and his own tent stove. The snow melters were protected on a wood floor with a tarpaulin windbreaker which was located about 100 feet east and to the rear of the kitchen and adjacent to an area which had been marked off with flags and maintained free from contamination (figs. 47, 48, and 49).

a. During the first couple of weeks, two Aeroil No. 98 Steam Thawing Units were used as melters, the steam lines were inserted into a full G. I. can of snow and as the snow melted it was replenished until there was obtained a full 32 gallons of water. When the units were functioning properly it required from 10 to 15 minutes, depending upon the temperature, to produce 32 gallons of water. The heat for these melters was furnished by a gas generator type burner which used kerosene and did not prove to be entirely satisfactory, the main trouble being



Figure 47. Pontoon snow melter which was designed to be used at 35-man emergency winter camp. Note exhaust from internal combustion engine furnishes heat for melter.



Figure 48. Inside snow melting shelter. Behind steam is Aeroil No. 98 Steam Thawing Unit. Man on left is holding steam pipe in G. I. can partly full of snow; man on right is pumping air into tank for burner which is bottom of steam thawing unit.

that it required considerable time to start the burners, especially in lower temperatures, and they required an excess of maintenance.

b. Army field immersion type heaters were used the majority of the time while on the ice and functioned properly without any mentionable trouble other than requiring a longer time to produce the water require-

ments. The G. I. cans were maintained about one-third full of hot water. As snow was added and became water, it was dipped out and poured into a covered container which, when full, was carried by hand to the kitchen. This operation was carried on by two men using four heaters who started to work at about 8:00 a. m. and by 3:00 p. m. (no time out for lunch) had obtained 14 or 15 32-gallon G. I. cans of water (448 to 480 gallons), the kitchen and mess hall requirements for 200 men (2.2 to 2.4 gal. per man per day).

c. The snow which was porous and had a specific gravity of about 0.35 at the top, was usually cut into blocks and carried less than 100 feet to the melters which were on the downwind side. Apparently, this snow had no mineral content and was free from harmful bacteria. The water was not chlorinated or treated in any way. Occasionally soot was found to be floating on the top of water cans, but did not hinder the production of potable water.

2. Waste Disposal.

Sanitation in the Antarctic where snow is extremely deep presents no problem so long as waste is not disposed of in snow melting areas.

a. Three latrines for the men and one for officers were suitably located throughout the camp. They were housed within 16- by 16-foot pyramidal tents and built similar to the ones for living quarters, with the boxes forming a U next to the back and two side walls. Urinals were not furnished and as a result conditions in front of tents became unsightly.

b. Garbage was disposed of by dumping it into a hole which was started by pouring hot dishwater onto the snow. All kitchen waste was disposed of in this hole, which was about 3 by 2 feet and became deeper the more it was used.

3. Heat.

Two types of heaters were used to heat the tent camp. Each pyramidal tent was equipped with one Army tent stove, Model 1941, and the standard oil burner, the mess hall and Quonset huts used 60,000-B. t. u. space heaters most of which were manufactured by The American Gas Machine Company, Albert Lea, Minnesota. Housing facilities remained comfortable at all times, except that the tents during high winds with low temperatures were uncomfortable even though the stoves were red hot. This was no hardship. Heating on Operation "High-jump" was adequate.

a. In order to reduce fire hazard, Diesel fuel instead of gasoline was used throughout and worked satisfactorily even though some of the stoves smoked at times. In case of the tent stoves, cleaning became necessary in about one-third of the cases. The average fuel consumption was about 8.2 gallons per day per tent stove and 125 gallons per day for the kitchen and mess hall (one tent stove, three 60,000-B. t. u. space heaters, and about seven kitchen ranges).

b. Standard hand type 15-pound CO₂ fire extinguishers were used throughout without any noticeable difficulties. They were distributed throughout the tent area so that one extinguisher served three tents, six or seven were around the kitchen as well as on the crash fire fighting sled. Others were placed around dumps and such places where they might be needed. No serious fires resulted although a number of tent poles became scored, with a couple of them collapsing.

4. Electricity.

The kitchen and mess hall were supplied electricity by two 5-kw., 120-v., single-phase generators driven by Wisconsin air-cooled motors which were housed in a tarpaulin shack beside the kitchen. The generators



Figure 49. Package shot (disassembled) snow melter.



Figure 50. Two 5-kw. generators which were used for lighting kitchen and mess hall. Note they are resting on the base for a tarpaulin which was later erected.

ran alternately in about 6-hour shifts and worked very satisfactorily. With the exception of those tents which required electricity for special projects, no power was furnished within the tent area. Most occupants of tents modified their quarters with one or two plastic windows or skylights which provided enough light for normal use.

a. It was originally planned to use two 75-kw. generators at the 35-man emergency winter camp, which was reconstructed at Little America III. Instead two, 25-kw., 200- to 400-volt, 3-phase, GM generators,

Model I-398 driven by 1,200 r. p. m. GM Diesel engines Model 3016 were installed and until date of departure furnished power for the high frequency radios. These generators were moved from the ship to the sites while still in the heavily constructed box-type house.

b. It was not planned to use these generators on the expedition other than to furnish power for six large reefers (675 cu. ft. each) which were constructed on the deck of the U. S. S. *Merrick* in order to furnish more cold storage space while en route to Antarctica.

SECTION VI. Airstrips and Snow Tests

1. Airstrip.

An airstrip, as originally planned, was not constructed, although three ski runways were prepared as well as a 150- by 350-foot plus 45- by 455-foot pierced steel plank test

strip. The R4D (C-47) planes operated off the ski runways very successfully and with less drag than normally would be encountered with tires on concrete.

2. PSP Test Strip.

a. The PSP test strip (figs. 51, 52, 53, 54, and 55) was laid in the following sequence:

23 Jan	.....	Detail of about 15 men started breaking open bundles and established center line.
24 Jan	Laid 150 by 75 feet of PSP on undisturbed snow.	Night shift started 1830 and finished 0530 on the 25th.
25 Jan	Laid 150 by 75 feet of PSP on burlap which was on undisturbed snow. Laid 150 by 75 feet of burlap on undisturbed snow.	Inspection of mat at 2200 hours revealed that PSP on undisturbed snow settled about 1½ inches, whereas mat on burlap did not settle. Most settling took place between 1030 and 1430, while sun was out, with light winds. Later inspection revealed no more settling.
1 Feb	.....	Started to remove 150- by 75-foot section of burlap.
3 Feb	..... 150 by 250 feet, 2 rounds with D-6 and snow drag over area where burlap had been. Laid 150 by 40 feet of PSP on partially compacted snow.	Removed burlap.

- 5 Feb Laid 150 by 160 feet of PSP on partially and compacted snow.
- 6 Feb
- 17 Feb 150 by 800 feet, 2 rounds with snow drag and D-6; 1 round with pontoon drag and D-6.
- 18 Feb 150 by 800 feet, 1 round with pontoon drag and D-6.
Laid 40 by 180 feet of PSP on partially compacted snow.
- 19 Feb Laid 40 by 275 feet of PSP on partially compacted snow.
- 20 Feb Removed snow from 150- by 350-foot strip
Runway extension had about 2 rounds with snow drag and 1 round with pontoon drag.

High was -8° F. with 16-knot wind.

7 men for $2\frac{1}{2}$ hours } 114 sq. ft.

13 men for $3\frac{1}{2}$ hours } man-hour

14 men for 6 hours equals 130 sq. ft./man-hour.

Fork lift with 3-inch lumber as a dozer pushed the snow to the sides.

b. The first 150 linear feet were laid about 25 January when temperatures were relatively high (25° to 30° F.) and the following difficulties were encountered:

(1) The small clips were difficult to handle in cold weather with gloves or mittens.

(2) Care had to be taken not to disturb the surface when the mat was to be placed (same as for construction of camp).

(3) The time required to carry each panel by hand from the runway shoulders to its final position was doubled, which was due to the soft névé. This work was performed mostly by the U. D. T. and ships' personnel who had no previous training in this type of work. Later this mat required a dozer (for lift with 3-inch lumber as blade) to remove snow drifts which were caused by miscellaneous bundles and odd pieces of PSP that were left within that area.

c. When the 40- by 455-foot section was laid on partially compacted snow the only difficulty encountered was the handling of the small clips, temperatures being about -10° F. with winds up to 16 knots. This



Figure 51. Laying PSP on burlap which was laid on undisturbed snow.

work was performed by about 13 Seabees from the motor pool whose morale was very high. During the 2-day period approximately 125 square feet per man per hour were laid.

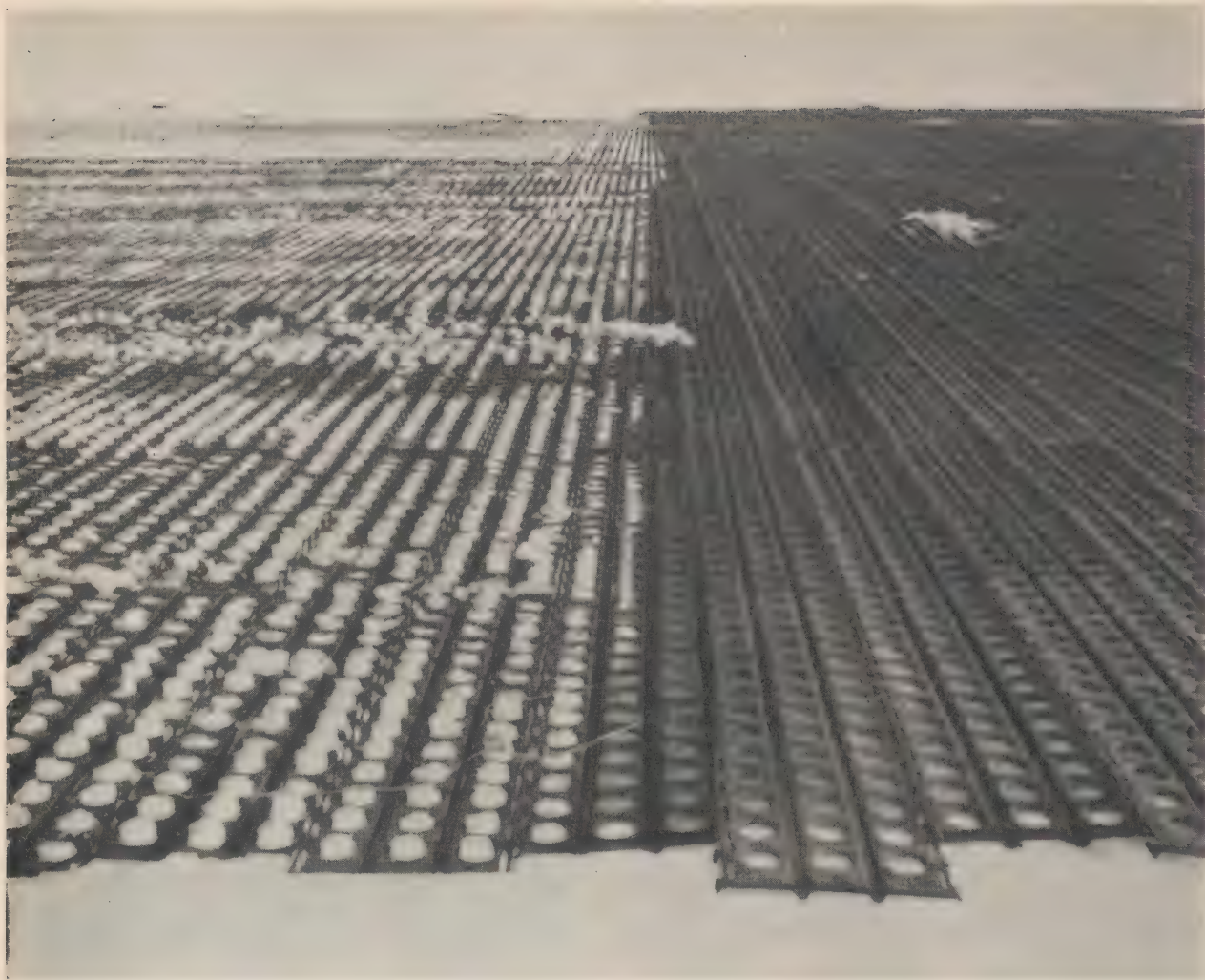


Figure 52. Junction of PSP direct on undisturbed snow (left) and PSP on burlap which is on undisturbed snow on right. Twelve hours after junction was laid, mat on left had settled from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches while mat on right did not settle at all.

3. Ski Runways.

The three ski runways were arranged more or less as an equilateral triangle, all work being performed by equipment, with no hand labor. The 4 days of construction for runway No. 1 (100 by 4,500 feet) started during the evening of 13 February and consisted of the following:

Runway No. 1 (fig. 58)

13 Feb 1 round, D-6 tractor pulling heavy drag.

13 Feb 1 round, D-6 tractor only.
 1 round, D-6 tractor pulling light drag.
 1 round, D-6 tractor pulling T-7 section of pontoon drag.
 14 Feb 1 round, D-6 tractor pulling light drag.
 1 round, D-6 tractor pulling pontoon drag. ($7\frac{3}{4}$ short tons, incl. 2 bdl. PSP).
 15 Feb 1 round, D-6 tractor pulling pontoon drag (a. m.).

- 15 Feb 1 round, D-6 tractor pulling light drag (p. m.).
- 16 Feb 1 round, D-6 tractor pulling pontoon drag (a. m.).
- 17 Feb 1 round, D-6 tractor pulling drag (far end only).
1 round, D-6 tractor pulling pontoon drag (far end only).

The average temperature during this period was -10°F . with winds at about 12 knots. Even after the first evening of work the surface furnished an adequate runway for skis. By 23 February this strip would almost support an R4D (C-47) on wheels. Runways Nos. 2 and 3 were constructed alike in that their 2-day construction period started 15



Figure 53. Same junction as in figure 52, showing that difference in elevation at this point is $2\frac{1}{2}$ inches.



Figure 54. Cylindrical snow pillars were left standing from $1\frac{1}{2}$ to $2\frac{1}{2}$ inches high as PSP, which had been laid direct on undisturbed snow, settled. They could be kicked over or scraped off very easily. Mat apparently did not settle any more after the first 36-hour period.



Figure 55. PSP test strip after a blizzard. Note drifts which were caused by bundles and odd pieces of mat left within area. This shows the runway areas must be policed as work progresses.



Figure 56. Tractor pulling pontoon drag on ski runway.



Figure 57. Track left after R4D (C-47), with wheels, had been towed from PSP test strip to ski runway No. 1. Tracks were almost waist deep in places.



Figure 58. Ski runway No. 1 running east and west. Picture was made before ski runways Nos. 2 and 3 were constructed.



Figure 59. OY (L-5) taking off from PSP test strip. Note that very little snow is blown up by the propeller.



Figure 60. OY (L-5) stuck in newly compacted snow at end of PSP test strip.

February and consisted of only the following: 1 round with a D-6 tractor pulling a wooden snow drag, and 2 rounds with a D-6 tractor pulling the pontoon drag. These were satisfactory for skis.

4. Taxi, Take-Off, and Landing Tests.

a. OY (Army L-5 on PSP, Subbase Partially Compacted, 20 Feb 47, +10° F., Wind 11 Knots.

(1) Several landings and take-offs were made from the 40- by 455-foot end as well as taxiing on part of the 150-foot wide end.

From all appearances no failure occurred. It is believed the weight was being carried by the mat instead of the snow base; therefore, very little or nothing was learned. The props seemed to kick up very little snow from beneath the mat, although a little loose snow which was on top was blown back.

(2) The plane taxied out over freshly compacted snow (2 rounds with D-6 tractor pulling snow drag, 1 round with D-6 tractor pulling pontoon drag) which, due to the surface failure, took considerable

power. When the plane tried to turn, one wheel went down and help was required to start plane moving again.

b. *OY (Army L-5) on Ski-Runway No. 1, 20 Feb 47, +10°F, Wind 11 Knots.* Several landings and take-offs were made with quite a bit of taxiing. With one exception no damage was noted. The surface acted the same as any prepared surface would be expected



Figure 61. OY (L-5) taxiing on ski runway No. 1.



Figure 62. R4D (C-47) taxiing on PSP test strip. Note that very little snow is blown up by the propellers.



Figure 63. Indentations up to 2 inches left in PSP after R4D (C-47) taxed on test strip (PSP laid on undisturbed snow).



Figure 64. R4D (C-47) stuck in partially compacted snow as it left PSP test strip. Fifty inches of mercury on both engines would not move plane. Note that no snow is blowing back as propellers rotate at high velocity.



granulated snow that could be raked out by hand. The snow beneath this was still compacted and no breaking through was noted. Apparently compacted snow will not stand abrasion. The tire pressure during these tests was 13 pounds per square inch and the total weight of the plane was about 2,100 pounds.

c. R4D (C-47) 19,000 to 20,000 Pounds on PSP Test Strip, 22 Feb 47, +10°F., Wind 5 Knots. (1) The plane taxied over the entire



Figure 65. R4D (C-47) tracks on ski runway No. 1 which show that it was not evenly compacted.



Figure 66. R4D (C-47) wheel after plane became stuck and had turned about 300°, using left wheel as pivot.

PSP test section. The mat which was laid on the burlap had the greatest failure. In places it was bent up to 2 or 3 inches. The mat which was placed on partially compacted snow bent to about 1 or 2 inches. This should show that, in this particular case, the tan and loosely knitted burlap acted as an insulator rather than a conductor, therefore losing the qualities which it was hoped it might possess. Had the burlap been canvas similar to that of tents, the results might have been slightly different, but it is still believed that best results would be obtained without using any material between the PSP and the snow. It was interesting to note that very little snow was picked up or blown out of place by the prop blast, even while both engines were pulling 50 inches of mercury. This also leads one to believe that no material similar to burlap is needed beneath the mat. It was also noted the tires had a tendency to skid easily where the mat was partially covered with snow.

(2) After taxiing on the PSP had been completed the plane tried taxiing off the end of the mat test strip and onto the partially compacted snow, but without success. The plane immediately sank about three-fourths of the way to the hub. Fifty inches of mercury on both engines would not move the plane. Later on during the night two D-6 tractors towed the plane over undisturbed snow to ski runway No. 1. This was accomplished in the same manner that a plane would be dragged through any muddy field. At one time one of the wheels went down to the point that loose snow, which piled up in front of the wheel, touched the oil cooler at the bottom of the cowlings.

d. R4D (C-47) on Ski Runway No. 1, 23 Feb. 47, +7° F., Wind 4 Knots. (1) The plane taxied about 100 feet before the left wheel went down. In trying to get out, the plane made about a 300-degree turn with the wheel going down to the hub. At times while



Figure 67. R4D (C-47) taxiing on main camp road leading to mess hall. No failure whatsoever was noted in surface.



Figure 68. Plane taxied into close quarters. Men pushing it backward while engines still running shows that there is very little drag between tires and surface.



Figure 69. Chocks were required to keep R4D (C-47) from rolling down main roadway, which had very little slope. This shows that there is very little friction between tires and surface.



Figure 70. Plane with ski landing gear leaves from ski runway No. 1 for long mission.



Figure 71. Ski track left by R4D on ski runway No. 1. Tracks are not usually this distinct.



Figure 72. Ski track as R4D (C-47) left ski runway No. 1. Note difference in track depth on runway and on shoulder.

taxiing the wheels would appear to ride on top, then one would break through and after running the engines up would come back on top. The surface definitely failed, but one could see that the minimum compaction for this type plane had almost been reached.

(2) During the noonday meal hour, the plane was towed over a connecting road to the mess hall road.

e. R4D (C-47) on Mess Hall Road, 23 Feb. 47, +7° F., Wind 4 Knots. (1) The mess hall road was part of the main camp road leading from the ships to the camp and had traffic continuously from 18 January through 23 February. The traffic consisted of every piece of equipment on the expedition, and no artificial compacting was done. There were occasional rounds with the snow drag which aided in keeping the area level.

(2) The plane was taxied up and down the roadway without showing any signs of failure whatsoever. The only markings or tracks left were formed by the tire tread and the loose snow which was on the surface. Twice the plane taxied in too close to the flagpole and was easily pushed back around by eight or ten men.



Figure 73. Tracks on ski runway No. 1 left by a Jeep as it started from a halt.

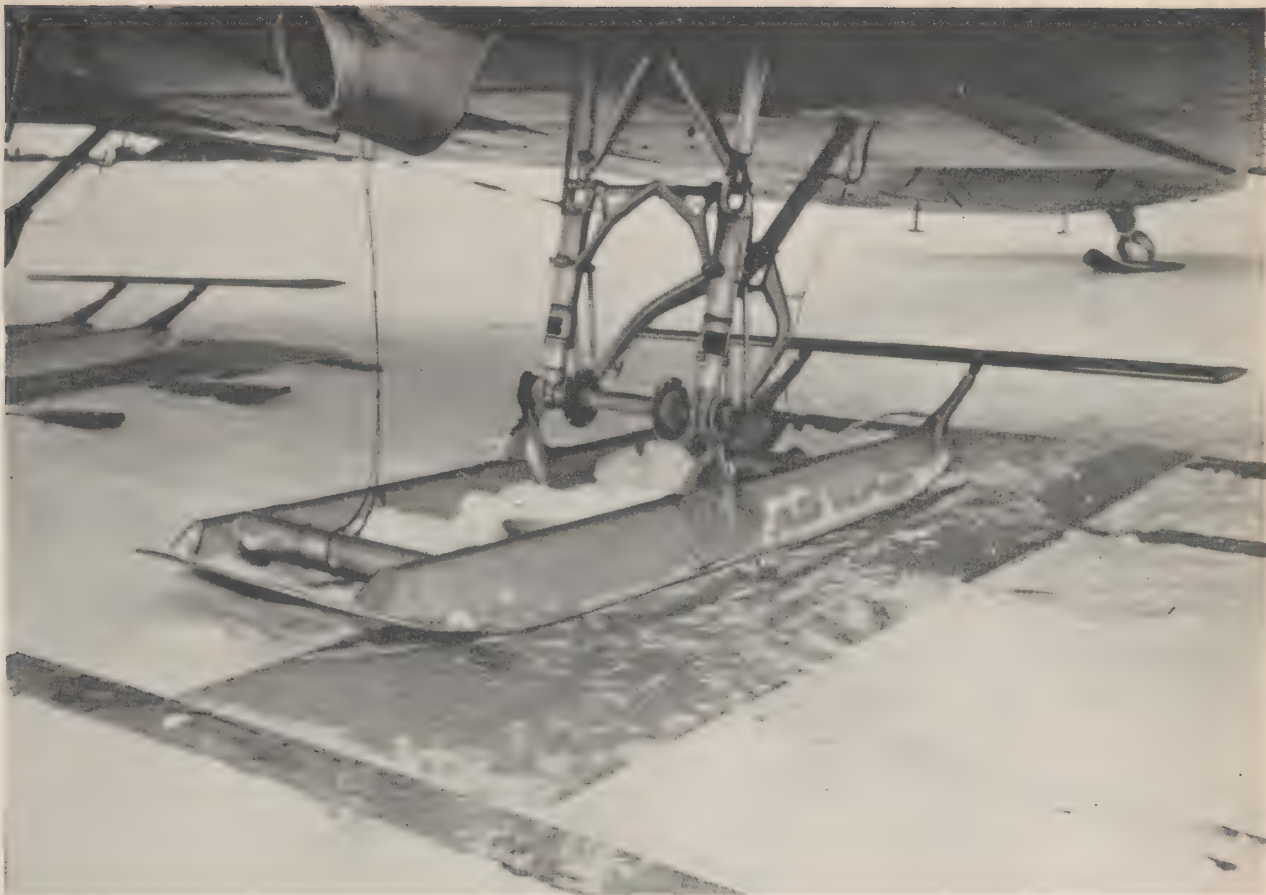


Figure 74. R4D (C-47) with skis, parked on plywood covered with Diesel oil to prevent skis from freezing to surface.

Figure 75. Removing snow sample for density measurements.



5. Snow Tests.

a. In-place density measurements, Proctor needle tests, and field load test were made on the following areas:

- (1) Undistributed snow.
- (2) Mess hall roadway.
- (3) Snow after PSP had been removed.
- (4) Ski runways Nos. 1 and 2.

During the short period on the snow, conditions varied from a soft sandlike consistency

with hardly any supporting power (while temperatures were near freezing) to a dense hard crust which would allow a D-6 tractor to travel without track extensions (temperature being near -10° F.). Due to circumstances beyond control, controlled tests were not started until the first part of February; therefore, no data was obtained during the warmer days.

b. The density measurements were made by weighing a carefully measured block of snow sawed from the névé. Successive segments, 1 to 3 inches thick, were sawed from the block as it sat on the scale. The residue was again weighed and measured and the reduction in weight and volume was used to calculate the density of the segment which had been removed. When crusts were observed in a specimen, segments were cut so

that one segment was composed entirely of the crust. It was found that compaction went to a depth of about 20 inches and that immediately after compaction the surface would not have the supporting power that it would after it had had a couple of days to freeze into place. Facilities were not available to make a microscopic study of the crystal arrangement, but it is the belief of the observer that the original grains of snow were broken down into smaller ones and compressed and vibrated into place, leaving a more dense surface.

c. In order to compare density measurements, the results of different tests were calculated and the value used in plotting specific gravity against depth. The average specific gravities for undisturbed snow, partially compacted snow (ski runways Nos. 1 and 3),

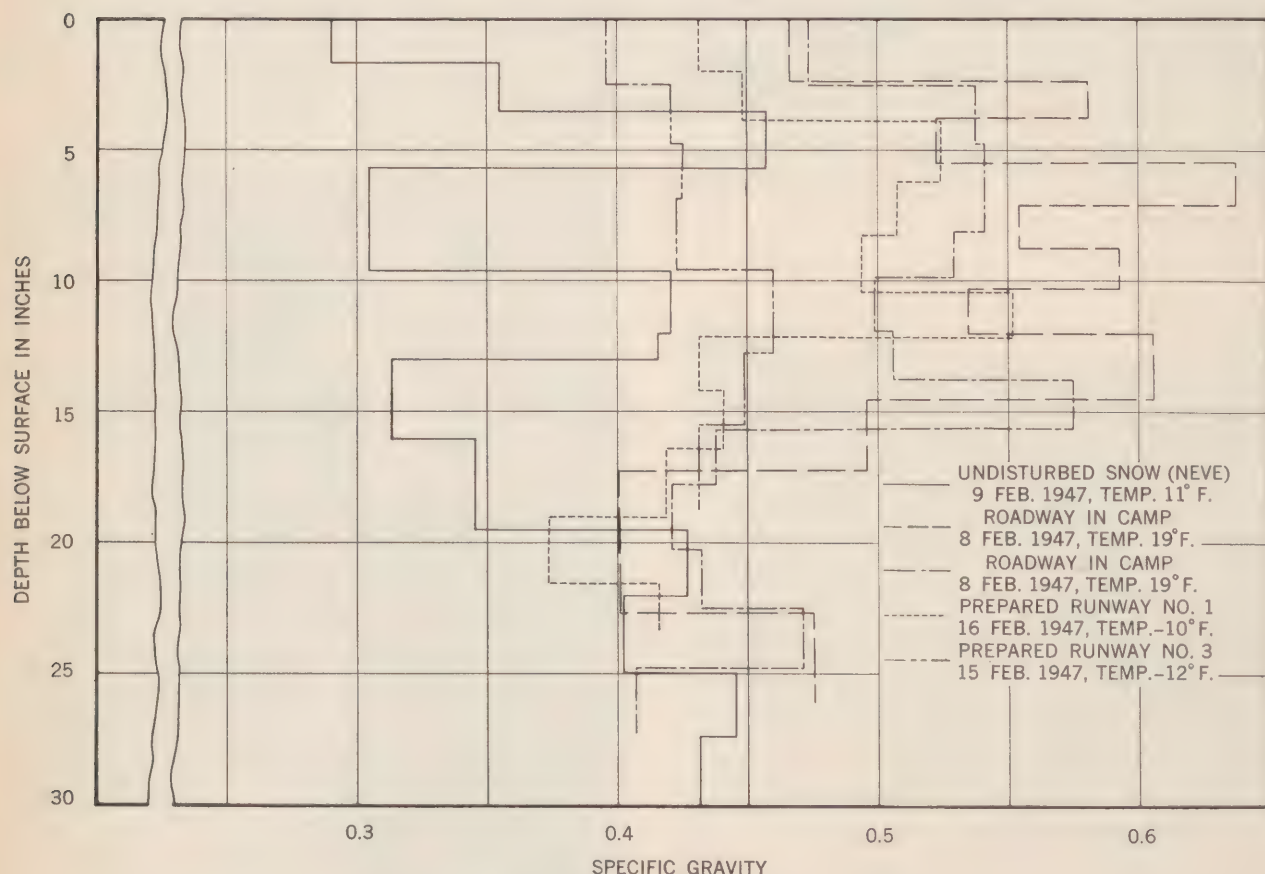


Figure 76. Comparison of density measurements.

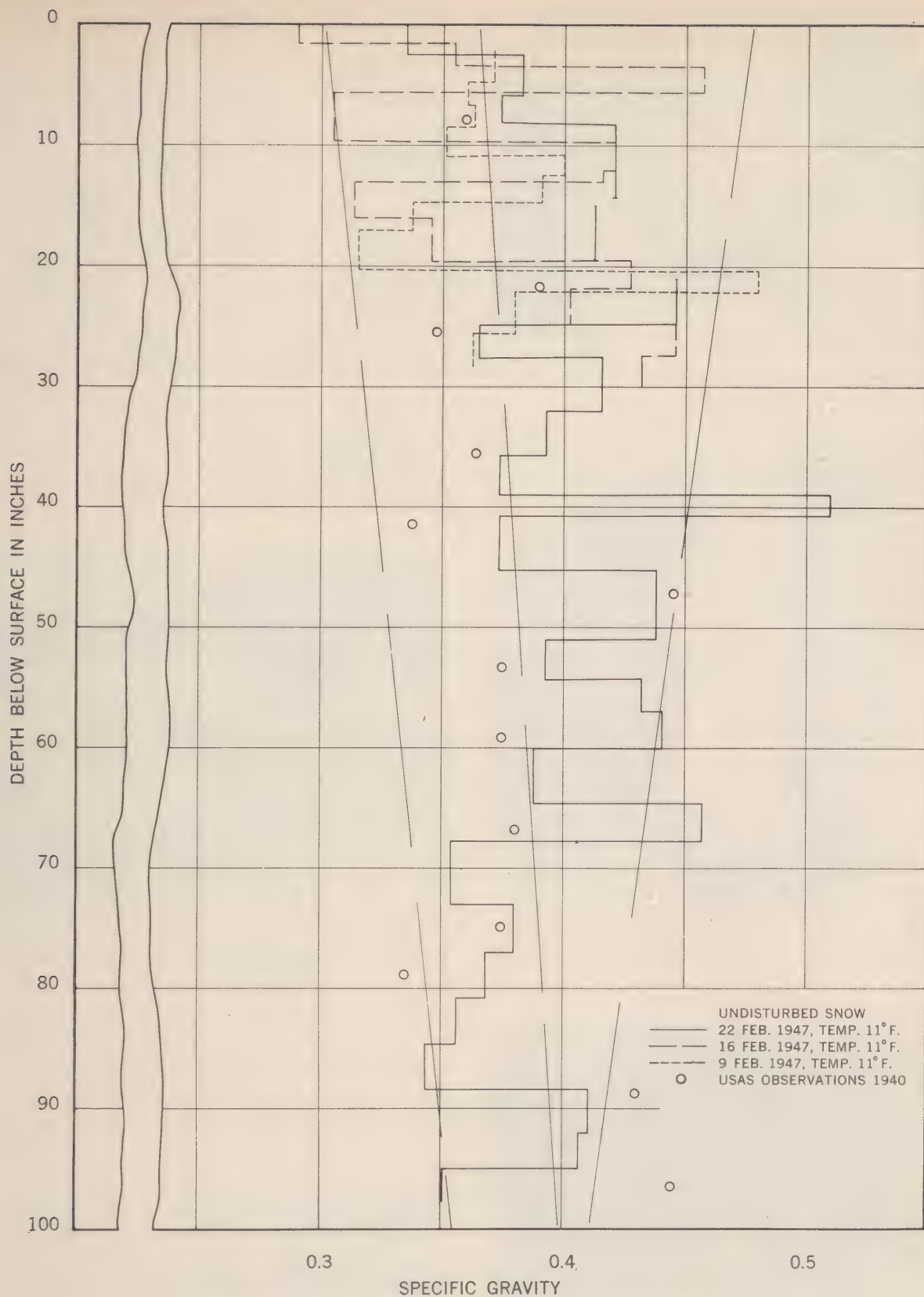


Figure 77. Further comparisons of density measurements.



Figure 78. Truing specimen for density measurement.



Figure 79. Weighing carefully measured specimen for density measurement.



and the mess hall road were used in plotting a graph.

d. Insufficient data was obtained to determine the degree of correlation between the bearing power indicated by the load applied to the small area under the Proctor needle bearing plate and the actual bearing power of the snow surface under working conditions, but it did indicate that a technique could be developed to utilize the Proctor needle to determine the uniformity of the results of any compacting operations and the relative bearing power of the snow.

e. Direct loads were applied to the snow by means of hydraulic jack using a D-6 caterpillar tractor to supply the load. The load was measured by means of a pressure



Figure 80. Running Proctor needle tests on snow after PSP had been removed.

Figure 81. Field loading test using 50-ton jack and D-6 caterpillar tractor on snow after PSP had been removed.

gage. Knowing the pressure and the area of the base of the jack (72.07 sq. in.), the unit load in pounds per square inch was

calculated. The following table is a comparison of load supporting power, Proctor needle pressure, and density measurements.

Location	Proctor needle		Specific gravity		Lbs.	Load	
	Lbs./sq. in.	Ratio	SP	Ratio		Lbs./sq. in.	Ratio
Undisturbed	27	1	0.332	1.0	1,300	18	1
Under PSP without burlap...	55	2	0.335	1.0x	2,000	25	1.4
Under PSP without burlap...	49	2	0.335	1.0x	2,000	25	1.4
Ski runway No. 3.....	257	10	0.396	1.2	.....	.....	.....
Ski runway No. 1.....	855	35	0.432	1.3	*4,300	60	3.3
Mess hall road.....	1,905	70	0.469	1.4	13,000	180	10

Note. Reasonable average values, utilizing all available data.
*C-47 wheel load calculated as 60 lb./sq. in. over base area of jack (72.07 sq. in.).

SECTION VII. Recommendations

1. General.

The recommendations herein are based on assumption that an Army engineer aviation battalion would be given relatively the same task with the same period of time as was originally planned (24 hours per day for 8 weeks). In many instances the recommendations will be in line with that which was practiced on this expedition. Others, of course, will be from experience gained by officers, men, and observers while carrying out the mission.

2. Staff Work and Planning.

a. It is recommended that planning be started far enough in advance to allow fabrication of special items and shipment, so that each unit will have ample time to familiarize itself with the items with which they are to work.

b. The unit chosen for the operation should be a well organized and experienced one.

c. It is recommended that the staff officer who is responsible for the planning be a member of the expedition. He will be able

to note his own mistakes, and pass on to others to follow, more complete information as to how future operations should be planned.

d. Plans should be flexible so that if at any time the over-all plan is changed, the operation could proceed uninterrupted.

e. A large amount of extra small tools, such as hammers, saws, wrenches, etc., should be taken since they become lost or misplaced very easily in the soft snow.

f. An extra amount of plywood, 2- by 4-inch, and 1-inch lumber should be taken, since additions must always be made.

3. Construction Equipment.

The most essential item for Antarctic work is specialized construction and transportation equipment. A certain amount was learned during the short 4-week period on the ice and it is felt that some of the answers were obtained, but there is still far more to be learned. No one or two pieces of equipment will answer all purposes. Each piece will vary in design depending upon the job it has to do. Some of the purposes for which equipment must be designed are as follows:

a. A heavy duty tractor or prime mover capable of pulling large quantities of supplies on sleds over great distances. The tractor should have living accommodations for its crew and should have a fuel capacity to carry it long distances.

b. A tractor similar to the ones used on this expedition which would be used in and around camp and on hauls for relatively short distances should be designed with following modifications:

(1) The power unit should need no changes other than a winterized hood.

(2) A cab that will protect the operator from low temperature and high winds.

(3) Tracks with a maximum unit bearing pressure of 3 pounds per square inch.

(4) Long tracks in order to prevent rough riding while going over the sastrugi as well as to aid in going over small cracks and crevasses.

(5) Attachable grouser plates, or something to give the tractor a foothold while working on ice.

(6) Winches on tractors are highly desirable.

(7) Correct the tendency of the tractor to mire itself while pulling heavy loads, possibly by moving the center of gravity forward.

c. Some type of light, fast-moving transportation suitable for transporting small numbers of personnel, etc., as the truck, $\frac{1}{4}$ -ton 4 x 4. It should have sufficient room to allow the operator to function properly while wearing bulky clothes and it should be easy to enter and leave. A winch on the front would be desirable.

d. Some type of cargo handling equipment, similar to a crane is most desirable. It is believed that a tractor crane would have been more suitable than was the forklift in that it would not be required to move around as much while unloading cargo. The 5-ton crane (Byer's Model 65), taken on this expedition, or one of its type would

not be suitable in that the center of gravity is too high and there would have been a great danger of its tipping over in the soft snow.

e. It is believed that compaction equipment will necessitate a complete change in design. It is felt that the tractor with the combination of weight and vibration did 90 percent of the compacting on the expedition. Various types of rollers were not used enough to determine their usefulness, but the consensus is that they act similarly to the way they would while rolling washed gravel or sand. Some type of equipment mounted on tracks will vibrate the granulated particles of snow into place, and after given time, the particles will freeze into position giving the desired results. Thought might be directed to something along the lines of a wagon, dirt or rock, bottom-dump, with a built-in vibrator and flat top so that weight could be added as the surface becomes more compact. Something on the order of a combined pontoon drag and snow surface heater should be considered, but not for compaction in depth.

f. Grading equipment will be necessary if airfields are to be built for extensive use by heavy planes. Several things have been

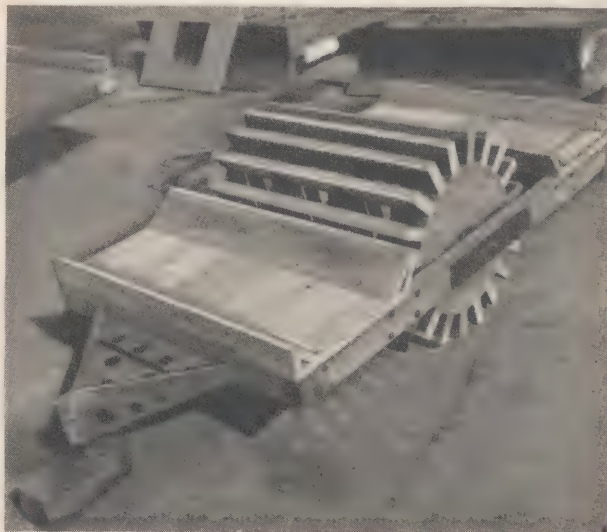


Figure 82. Open snow roller.

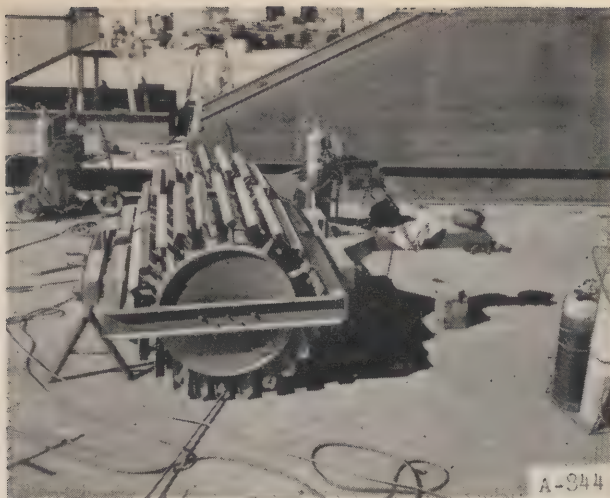


Figure 83. Modified sheepfoot roller (not used).

discussed such as a towed grader mounted on skis instead of wheels, and motorized graders 4 x 4 with large dual tires front and rear. The skis would have the disadvantage of side slippage, and attachable skis would have to be furnished the motorized grader to transport the machine to the compacted surface where it is to work. Personally, the observer would like to try the latter. Due to the belief that it would be easier to grade a runway after it is partially compacted it is felt that the motorized grader would be more satisfactory even if assistance had to be given by a tractor towing for the first few gradings. Once the surface became hard (before ready for planes) the grader could work as it normally would as well as travel back and forth to the motor pool under its own power.

g. The main suggestion on the sleds is that the runner contact area be increased so that when fully loaded there will be a unit bearing pressure of from 2 to 3 pounds per square inch. This, of course, will present a problem in that the larger the runner area the harder it will freeze in when left standing. A runner might be designed for a higher unit bearing pressure so that shoes

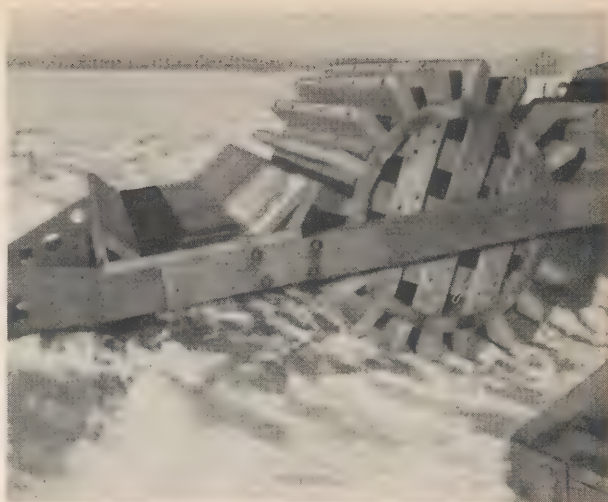


Figure 84. Closed snow roller which proved unsatisfactory.

could be attached which would bring the unit bearing pressure down to that which is desired during high temperature when the névé is quite soft. The QM 1-ton sled, which is definitely a good one, could be supplied with a tarpaulin similar to those on trucks so that while transporting personnel they would be protected from wind and snow which is kicked up by the weasel or towing vehicle. The "Go-devil" sled, as used on this expedition, could be redesigned with a toboggan undercarriage so that, when mired, snow would not pile up in front. The side-board recess could be lowered in order to allow large and awkward-shaped cargo and boxes to rest flat on the bed.

4. Cargo Handling and Unloading.

a. Each unit should definitely check all items prior to leaving its home base or port. As before an invasion during the war years, the unit should assure itself that all items are present and that the boxes and crates have been properly and conspicuously marked with some color or symbol.

b. Ships should be loaded in accordance with an established priority and with each unit's supplies together, in order that one



Figure 85. When camp was evacuated caches were left well marked with high poles and identification on top so that they may be found if needed for later expeditions.

group may be unloaded without disturbing the others.

c. Men and officers should be transported on the same ships as their supplies and equipment.

d. During the first stages of the operation each unit should cache its own supplies; that is, engineer troops should unload their own supplies as they arrive at the camp site, air corps personnel should unload their supplies, etc., for all branches of the service and their units. Within each unit it would be advisable for cooks and KP's to cache their own kitchen supplies, mechanics unload their supplies, etc. This would familiarize each person with location of his supplies and how they are stored.

5. Buildings and Structures.

a. It is thought that the temporary camp construction could possibly have been a little more complete, even though it furnished adequate shelter. Inside framework and doors could have been erected by the Seabees which would in turn save individuals from taking time off to construct on their own.

b. It is recommended that some new type of prefabricated building be designed for

permanent or semipermanent building in regions similar to those in the Antarctic. This design should provide the following:

(1) Rapid and easy assembly, possibly with clamps or some type of fastener other than small items such as nails and bolts which are hard to manipulate while wearing gloves or mittens.

(2) Maximum insulation, yet the panels should be light enough to allow three or four men to handle with ease.

(3) Panels or sections of such size and weight for minimum shipping weight and cubage.

(4) Floating foundations.

(5) Double floors with air circulation between the two.

(6) Plenty of headroom in order to allow for double bunks.

(7) Skylights or windows to provide light until such time as they become covered with snow.



Figure 86. Early stages of crevasse in barrier slope. Later it became about 5 feet wide in places.



Figure 87. Looking up from down in a crevasse. Cracks such as these are obstacles which may be encountered.

(8) Strength to withstand winds up to 100 m. p. h., and snow and ice pressure which will be from the sides as well as from the top.

c. If possible it would be advisable partially to compact the construction area before erecting any buildings or even tents. This would enable the working parties to move around with greater ease, afford better footings for building, as well as keeping the construction area level.

6. Utilities.

a. Water supply is the only utility which requires serious thought. The area from which snow is to be taken should definitely be on the windward side of the entire camp area and must remain a restricted area so that it will not become contaminated. Some type of semiportable snow melter is needed. It should be designed so that the water will be maintained at a given level. The water from the time the snow enters the hopper until it is ready for use should be in closed containers and changed from the melter to storage tank through pipes in which the

water could be continuously circulating to prevent freezing. For large or more permanent types, heat could be supplied from the exhaust of an internal combustion engine as was planned for in the 35-man emergency winter camp.

b. As a morale factor and for convenience it would be advisable to furnish electric lights to all tents and buildings.

7. Airstrips and Snow Tests.

The following recommendation for construction of an airstrip is by no means the cheapest or most expedient, but is a method which it is known will supply the needs. Future research and study of snow characteristics will undoubtedly develop techniques of construction which will enable units to prepare surfaces in less time and to carry heavier loads. The method suggested would probably not be carried out in its entirety, but would change as construction progressed, depending upon knowledge gained during this period.

a. Suppose the specifications called for one runway 100 by 5,000 feet to accommodate C-47 type planes 1 month after starting date and heavier type planes later. Two areas side by side 500 by 7,000 feet each could be compacted by the use of tractors and drags running back and forth over the surface as was the method in compacting the ski runways. If a track laying type compactor were available it would aid considerably. In about 1 month the center 100 feet of these strips would be compacted to its maximum density, specific gravity of about 0.65 to 0.70 at the surface down to about 0.40 or 0.45 at 20 inches below the surface. It would be ready for C-47 type aircraft. The object of having two runways would be that while one was being used the other could be maintained and worked for heavier type planes. The runways would then be strengthened by dozing snow from the ditch lines onto the 100-foot center strip and compacting in the



Figure 88. Crevasses such as these are encountered in the Antarctic.

same manner. After this operation had been accomplished two or three times the runways should be capable of carrying the C-54 type aircraft.

b. Total construction time for this operation should take approximately 6 weeks. Due to surface winds and snow the ditch lines would become filled by drifts affording additional material which could be dozed up onto the 100-foot center strip. It is thought that eventually the depth of compaction would become great enough to afford ade-

quate bearing pressure for larger aircraft in the heavy bomber type group. The reason for compacting the 200-foot shoulders on both sides of the runways at beginning of construction is that the undisturbed névé will not otherwise support construction equipment. Due to the fact that after compaction the snow requires a period in which to re-freeze it might be well to bear in mind that doubling the construction force does not necessarily mean cutting construction time in half.

c. Prefabricated landing mat should be available, even though it would not be planned to use it, due to the fact that once it is in place the depth of compaction could hardly be increased. It would also afford quite a problem in keeping the runway clean after blizzards, in that snow piles would accumulate on each side of the runway which would cause drifts to grow larger the more the strip is cleaned. Even though a runway without a mat surface might show wear and become damaged during heavy operations it is believed that maintenance would be a relatively simple proposition.

d. At this particular stage it is felt that the most important thing in connection with runway construction in regions similar to the Antarctic is that more experimental work be carried on similar to that which was carried on during Operation "Highjump." The snow should be studied by constructing runways and performing such tests as those performed and planned to be performed on this operation.

e. For more detailed information on this operation, it is suggested that the Navy's BuDocks report on the operation "Highjump" be studied.

TRANSPORTATION

SECTION I. Introduction

1. Plans and Objectives.

The plans and objectives of Operation "Highjump" in the field of Transportation are set forth in paragraph III-B, Annex "J", Commander Task Force 68, Operation Plan No. 2-46, Projects:

* * * * *

(1) Performance and tests of powered vehicles under Antarctic conditions.

* * * * *

2. Scope.

a. At the end of the shore based operations on the Antarctic Continent, the personnel who actually operated and maintained the motor vehicles used there returned to the United States in a different ship than that which carried the Army observers; hence, considerable valuable data which should logically be contained in this chapter are not now available, but will undoubtedly be included in the final reports of Task Force 68.

b. The time spent in the shore based phase was so short that it scarcely constituted a proper performance test for the vehicles concerned. The vehicles were placed ashore commencing about 18 January 1947, and final evacuation of the base camp was completed on 23 February 1947, a period of only 36 days.

3. Vehicles.

Powered vehicles placed ashore at the Bay of Whales for operational use and testing were as follows:

a. Wheeled vehicles:

8 Trucks, ¼-ton, 4 x 4 (Jeep).

4 Trucks, 2½-ton, 6 x 6.

1 Truck, 1¼-ton, 4 x 2.

b. Amphibious vehicles:

8 Cargo carriers, M29C (Weasel).

2 Landing vehicles, tracked.

c. Tractors:

10 Tractors, D-6.

1 Tractor, D-7.

2 Tractors, TD-9-6C (Fingerlift).

3 Tractors, MC-1 (Cle-track).

Note. The vehicles listed in *a*, *b*, and *c* above were all new vehicles.

d. The following drawn conveyances were used and are considered in this report:

20 sleds, 10-ton (Go-devil).

8 sleds, Army, 1-ton.

3 trailers, tank, 800-gallon capacity, mounted on skis.

e. Also included were the following dogs and dog sleds:

27 dogs and 4 dog sleds.

4. Unloading Vehicles.

The ships moored direct to the bay ice in the Bay of Whales, and all vehicles were unloaded direct onto the ice in the conventional manner by cargo slings.

5. Surface Conditions Encountered.

a. The bay ice in the Bay of Whales was covered by hard packed snow (névé) varying in thickness up to 18 inches. There were two tide cracks or crevasses in the bay ice which had to be crossed. These tide cracks

were several feet wide and the interval was choked with pressure ice; the pressure ice in places was piled up 12 to 15 feet high over the tide cracks. These cracks were bridged for safety. Bulldozers pushed away the surplus pressure ice and the bridges were constructed of planking, pierced planks (airfield matting) and other available materials. These bridges had to be constantly maintained because of the heavy traffic over them and because of movement of the ice at the tide cracks. At the site selected for the ascent of the barrier, the barrier was about 70 feet high and sloped down to the bay ice at an angle of 20 degrees from horizontal.

This slope was about 200 feet long (fig. 89). The slope consisted of hard packed, drifted snow, covered with soft snow. On this barrier incline there were later discovered two crevasses, originally only about 2 feet wide but later opening up to about 5 feet. Initially these crevasses had been covered by a natural snow bridge which gave way under the pounding of heavy traffic.

b. The top of the barrier was covered with névé snow which was considerably softer than that found on the bay ice. The surface in some places was smooth; in others it was crossed by ridges and hard snow (sastrugi) varying in height from 5 inches



Figure 89. D-6 in reverse towing working party up barrier incline on five Army sleds.

to several feet. The spacing and height of these ridges varied from day to day. The surface texture, bearing power, and other physical characteristics of the névé vary with temperature, wind, sun, and other climatic influences; thus, conditions of operations may change within a few hours. The general surface contours of the Ross Ice Barrier in the vicinity of the Bay of Whales are quite gradual; slopes of over 10 to 15 degrees are rare. The surface of the barrier contains many crevasses up to 10 feet wide and wider. These crevasses frequently are covered by a bridge of crusted snow which will give way under a heavy vehicle. Of the vehicles considered in this report only the LVT's participated in an overland trail operation. Ability to cross crevasses must always be considered for a vehicle designed for Antarctic operations.

6. Wheeled Vehicles.

No wheeled vehicles were able to operate efficiently ashore. All had to be towed from shipside to motor park. The larger trucks were never able to operate, although the Jeeps were able to operate to a limited degree on well packed areas when equipped with heavy chains on all four wheels. The Jeeps were so unreliable, however, from a transportation standpoint that they were useless. The snow acted very much like soft sand, causing the wheels to dig out great holes when power was applied. Four of the Jeeps were equipped with power generator units and were finally towed to the top of the barrier and used as power generators for the air operations office. Wheeled vehicles of conventional type are entirely unsatisfactory for personnel or cargo carrying purposes in the Antarctic.

SECTION II. Cargo Carrier, M29C

1. General.*

a. No trials were run in water, the Weasels operating exclusively on snow and ice throughout the operation. They were used as liaison vehicles and for towing the 1-ton Army (QM) sled. They were in almost continuous operation and turned in a very creditable performance. They towed the Army sled with a 1-ton load of cargo or personnel with ease on the bay ice, up the barrier incline, and on top of the barrier itself. The principal complaint against the Weasel was that there were not enough of them. Eight Weasels could scarcely perform all the tasks desired of them. The demand for Weasels was never satisfied during the operation.

b. The following table shows the total number of miles of operation by each Weasel for the period 19 January 1947 to 23 February 1947:

Weasel No.	Mileage
1	1,464
2	1,099
3	1,201
4	1,571
5	Lost in crevasse—figures not available.
6	38—Front suspension damaged and track broken shortly after landing. Never repaired or replaced.
7	1,464
8	1,027

2. Method of Use.

Initially Weasels were assigned to various individuals or departments for use. There were, however, more interested agencies than there were Weasels. This resulted in a

*See TM 9-772 for general description and technical data concerning Cargo Carrier, M29C.



Figure 90. Weasel in trouble in soft snow.



Figure 91. Weasel comes in handy for photographic work.



Figure 92. Weasel advertising cancer drive. Note QM 1-ton sled in rear.



Figure 93. Photographic Weasel on airstrip. Note how tracks conform to irregularities of surface.

bottleneck on these vehicles and controversy over the priority of the projects concerned. About 27 January 1947 the Weasels were placed in a common pool operated by the motor maintenance officer. Thereafter all requests for Weasels were handled by a dispatcher, who, by coordinating individual requests, was able to maintain a much more efficient use of the vehicles. A scheduled "run" was instituted on a 30-minute basis between the ships, the base camp, and the airstrip. This greatly relieved the strain and operated as accommodation to observers,

civilian scientists, correspondents, and other casuals. One exception to this arrangement was in the case of the Weasel permanently assigned to the camp surgeon. This Weasel remained on call at the air operations office near which the surgeon's headquarters was located. This vehicle and an Army sled were used as an emergency ambulance and crash truck (fig. 94). The equipment included fire fighting equipment, stretchers, and other first aid and medical gear. This Weasel was the only one equipped with a radio.

3. Tracks.

All Weasels were equipped with the conventional track. These tracks proved quite satisfactory in most respects. The only time a Weasel was deadlined because of track failure was in the case of one which was broken. However, it was noted that when a Weasel was parked on a rutted or uneven surface, wrinkles or ridges in the rubber belts would appear as the tracks conformed to the irregularities of the surface. After one or two hours in the same position, these wrinkles or ridges tended to stiffen in that position. It was feared that a break in the steel cables embedded in the rubber belts might occur if the vehicles were driven off immediately. It was therefore deemed advisable to move the Weasel a few feet forward and backward, repeating this movement several times until the wrinkles or ridges were ironed out. Further study into the possibility of cable breakage from these conditions is recommended. If such breakage might result, the feasibility of individual block type tracks with connectors might be investigated.

4. Serviceability and Performance.

a. Of the eight Weasels placed ashore on or about 19 January 1947, six were serviceable and in operation when the base camp was evacuated on 23 February 1947. As stated previously, No. 6 was disabled after 38 miles of operation by a broken track and a damaged support tube and carrier arm, resulting from a collision. As no spare parts were available this vehicle remained out of operation. No. 5 Weasel was lost in a tide crack, or crevasse, in the bay ice on 15 February 1947. After the cargo ships departed on 6 February the bridges were not maintained and soon became unuseable due to ice movement. The driver of No. 5 Weasel attempted to cross one of these crevasses near the bridge site. As the Weasel passed over the crevasse the pressure ice

between the edges of the crevasse gave way and permitted the vehicle to drop into the water. For some reason the drain plugs had never been installed and the hull began to fill with water. Every effort was made to save the Weasel. Water was bailed out of the hull, planks and empty gas drums were lashed to the sides and eventually a tractor arrived at the scene. When the tractor arrived a cable was attached to the capstan of the Weasel and an attempt was made to drag the Weasel onto the bay ice. This attempt failed when the capstan tore loose. The towing pintle could not be used because by the time the tractor arrived the hull was almost full of water and the towing pintle was out of reach. Shortly thereafter the Weasel sank in over 200 fathoms of water. It is recommended that drain plugs be installed in all Weasels which have occasion to travel on bay ice.

b. Two Weasels were temporarily disabled by damaged transmissions during the first 10 days ashore. In one case a tooth was broken from the low range gear. A new tooth was built up by welding and filed as near to size as possible. This enabled the vehicle to resume operation to a limited degree; how-



Figure 94. Weasel and 1-ton Army sled used at airfield as combination ambulance and crash truck. Note fire extinguishers.

ever, the transmission could be shifted into low range gear only with difficulty, so to prevent further damage to this gear a lug was welded to the axle transmission lever in such manner that the transmission could not be shifted into low gear range. Thereafter the vehicle was limited to high range only. In the other case of a damaged transmission, the nature of the damage is not known, other than it rendered the vehicle inoperative. It was reliably reported that this transmission was replaced by the transmission of No. 6 Weasel (with the broken track). In any case the Weasel was placed back in operation.

5. Transmissions.

As stated in the paragraph above, two Weasels were disabled by damaged transmissions although both were repaired or replaced quickly and placed back in operation. The general opinion of most individuals who worked with the Weasel is that it has a weak transmission. However, when operated by a trained driver it appears the transmission seems to perform satisfactorily. Weasels on the operation were frequently driven by amateur drivers with little or no previous experience. It is possible that the two damaged transmissions were caused by inexperienced drivers placing undue strain on the transmissions by selection of wrong gear range, clashing the gears in shifting, or "jerky" take-offs.

6. Speed.

Weasels operated at speeds up to an estimated 15 miles per hour both on the well packed roads and on the open snow of the bay ice and the barrier. It was a common tendency to drive the Weasel too fast, the speed being regulated more or less by the comfort of the driver and passengers. It is recommended that 10 miles per hour be considered as the maximum speed consistent with smooth operation. Beyond that

speed the vehicle has a tendency to bob up and down quite forcibly from the axis of the drive sprockets. During this motion the rear part of the tracks maintains a more or less constant contact with the snow while the forward part of the tracks rises off the snow from a few inches to more than a foot. This "down buck" results in jolting the passengers and a jerking motion to a towed sled. It seems logical to assume that additional strain is also placed on the tracks, track suspension, and power drive. It was observed that this "down buck" was more pronounced on uneven surfaces. Actually, there are no absolutely level surfaces in the Antarctic; even though a surface appears to be perfectly flat to the naked eye it is usually full of minor dips and swells. It is believed that the intermittent strain caused by high speeds over uneven surfaces causes a torque component to be built up which definitely aggravates the normal bobbing motion imparted to the vehicle in passing over these uneven surfaces. It is possible that if the drive sprockets were in front rather than in rear a smoother operation of this vehicle could be obtained. The feasibility of front drive should be investigated.

7. Engine.

There was no ignition trouble, no carburetor trouble, and no trouble with engine starting. S. A. E. 10 oil was used in the crankcase. Sixty percent prestone was used in the cooling system. The electrical system functioned normally. No differential failures were encountered.

8. Feasibility of Use in Prolonged Operations.

No prolonged trips were made with the Weasels. The longest trip was to Little America I (1929), a distance of approximately 12 miles. However, observations of the vehicle in operation indicate that it might be feasible for use in extended oper-

ations, limited only by fuel, oil, maintenance supplies, and extremely unfavorable terrain, especially wide crevasses.

9. Drivers.

There were regularly assigned drivers for each Weasel from the Seabee detachment. These drivers had had previous experience and were reasonably well trained. However, quite frequently the Weasels would be operated by individuals who had little or no previous experience. The performance of Weasels chauffeured by the regularly assigned drivers was much superior to that when chauffeured by amateurs. The chief characteristics of amateur driving were jerking the vehicle in starting off, selection of improper gears and driving range, a tendency to drive too fast and "lugging" the engine.

10. Observations.

Several observations were made concerning possible modification of the Weasel:

a. The high sides of the hull resulting from its amphibious feature make it rather difficult for driver and passengers to enter and leave the vehicle. If the amphibious feature can be considered unnecessary for operation on the Antarctic mainland, a portion of the hull could be cut out and doors installed.

b. Present side curtains provide scant visibility to the occupants. The feasibility of a rigid cab with glass or plexiglass windows should be investigated.

c. None of the Weasels were equipped with defrosters for the windshield. Frost did not form on the windshield except when the side curtains were tightly fastened. For prolonged trips in extremely low temperatures requiring the side curtains to be closely secured for warmth, a windshield defrosting unit is indicated.

d. When traveling at moderate to high speeds, the tracks kick snow very forcibly over the towed sled. This is a most uncomfortable sensation for personnel riding on the sled. The feasibility of some type of guard over the rear of the tracks to prevent this from occurring might be investigated.

e. The driver was definitely handicapped by the narrow space between the right steering brake lever and the engine cover. With heavy clothes and shoes it was very difficult to reach the foot throttle and the driver's leg was pinched by the steering brake. This space should be made wider to accommodate the bulkiness of Antarctic footgear.

11. Conclusion.

The Weasel proved to be a most satisfactory vehicle for operation on the Ross Ice Barrier. The expedition could have efficiently used more of these vehicles. The four chief failures of these vehicles, i. e., one broken track, one vehicle lost in a crevasse, and two damaged transmissions, cannot be directly attributed to inherent weakness in the vehicle.

SECTION III. Tractors

1. General.

Tractors were the mainstay of the shore based phase of the operation as far as transportation was concerned. Over 3,000 tons of cargo were moved from the ships to the airstrip, the base camp, and the 35-man

emergency camp. The great bulk of this cargo was hauled by tractors. Except for the Cle-tracks, all tractors were found to perform with reasonable efficiency under all conditions encountered.

2. Fingerlifts (Figs. 95, 96, 97, and 98).

The two fingerlifts were so seldom used as transportation in the sense of towing drawn conveyances that they are considered in this report only from the standpoint of their performance under prevailing conditions in view of their similarity in many respects to the D-6 and D-7 tractors. The fingerlifts were equipped with wooden track extensions and operated most efficiently both on the bay ice and on the barrier. They

were extremely valuable in unloading cargo from sleds at the various caches. The fingerlifts were too light for some of the heavy loads they had to handle. The tracks on both fingerlifts became slightly sprung due to bending of the bogie and idler shafts. This was probably due to leverage exerted by the track extensions when heavy loads were lifted. Both fingerlifts continued operating throughout the operation.



Figure 95. Fingerlift distributing pierced plank on the airfield.



Figure 96. Load of lumber and tarpaulins on fingerlift.



Figure 97. Fingerlift digging out pierced plank buried in snow.



Figure 98. Laying out cache with fingerlift.



Figure 99. D-7 as "deadman" for hauling loaded sleds up barrier.



Figure 100. Looking down barrier incline. Tractor on bay ice is towing loaded sled up barrier with cable towing device.



Figure 101. D-6 in reverse towing Norseman plane up the barrier.

3. D-7 Tractor.

The D-7 Tractor would probably have turned in a much more creditable performance than it did, had it been given a proper trial. Its chief contribution to the transportation cause was in being used as an anchor or "deadman" (fig. 99) at the top of the barrier. The bulldozer blade was dropped and forced into the snow and two large timbers were thrust into the snow to assist in firmly anchoring the tractor. To the firmly anchored tractor were attached two snatch blocks. By means of a 1,200-foot length of cable operating through the snatch blocks a D-6 tractor at the base of the barrier was able to tow loaded sleds up the face of the barrier incline (fig. 101). The D-7 tractor was used as a "deadman" at the top of the barrier from 20 January 1947 until the cargo-hauling from the ships was completed on 6 February 1947, when it was evacuated. The wooden track extensions provided for the D-7 were 60 inches long (fig. 102). Although not given a thorough test it was considered that these extensions were longer than necessary.

4. D-6 Tractor.

The 10 D-6 tractors were the work horses of the entire shore based operation, and from the transportation standpoint they were responsible for the success of the operation.

5. Winterization.

All the tractors had been winterized at Port Hueneme, California, prior to embarkation. This winterization included enclosing the driver's compartment in a cab, covering the hood and radiator with sailcloth, 60 percent prestone in the radiator, and winter oil (Naval equivalent of S. A. E. 10). In anticipation of traction difficulties in the snow, wooden track extensions were prepared for installation after the landing in Antarctica (fig. 102).

6. Cab.

The driver's cab was a wooden frame and top with safety plate glass puttied in in front and with plexiglass bolted in on the sides and rear. The door opened on the left side. The door was rather poorly made, especially the latch, which failed to hold the door closed until field expedients were utilized. The cab provided ample vision for the driver. Very little difficulty was experienced with glass frosting over but occasionally visibility would be lessened by snow or sleet. The plexiglass on the sides and rear would frequently tear loose from the bolts which secured it. An escape hatch 2 feet square was built into the top of the cab. All in all the cabs were satisfactory. Certainly a cab of some type is needed for Antarctic operations.

7. Track Extensions.

All tractors could operate efficiently on the bay ice without track extensions, although occasionally one would stick from turning too sharply or in starting a heavy load (fig. 104). Tractors which operated exclusively on the



Figure 102. Layout of track extensions, showing both 60-inch and 30-inch types. D-6 tractors used only 30-inch extensions on Operation Highjump.



Figure 103. Parked tractors. Note broken and missing track extensions.

bay ice were therefore not equipped with track extensions. They were able to tow two Go-devil sleds each carrying 3 or 4 tons of cargo with ease.

a. In general, none of the tractors could operate on top of the barrier without track extensions. The snow on the barrier was much softer and deeper than on the bay ice. After track extensions were installed a D-6 tractor could tow three Go-devil sleds each carrying $4\frac{1}{2}$ tons of cargo with ease (fig. 105). All tractors operating on top of the barrier were therefore equipped with track extensions.

b. The incline from the bay ice to the top of the barrier was quite a different proposition. The 20-degree incline approximately 200 feet long proved to be a major obstacle. Tractors without track extensions were not able to climb this incline even without loads. Tractors with track extensions could climb the incline without a pay load but experienced the greatest difficulty in towing a single loaded Go-devil sled. When these initial attempts were made on 19 January 1947 the snow on the incline was quite soft. The tractors tended to mire in on one side and corkscrew about at right angles to the

original direction, then being unable to resume the original direction. By reversing the tractor and pulling backward, better results were obtained. An experiment with two tractors in tandem, both pulling backward, proved that one Go-devil sled with 2½ tons of cargo could be hauled up the incline.

c. Before any appreciable amount of cargo had been hauled up the incline, the tractors had badly chewed up the surface, gouging out deep holes in the snow. This activity broke the natural snow bridge, or snow crust, over the two large crevasses which ran parallel to the barrier across the track. These crevasses were about 2 feet wide when discovered, but had widened out to about 5 feet at the end of the operation. Hauling cargo with tractors was suspended after one tractor bogged down in one of these crevasses and had to be towed out. Then the prearranged plan of using a cable towing device was used. The D-7 tractor was installed on top of the barrier as a deadman and by means of two pulleys attached to the deadman and 1,200 feet of wire cable, the loaded sleds were towed up the incline by a tractor operating on the bay ice. The crevasses were filled up with

snow by bulldozers. This snow supported sleds and Weasels. Tractors were kept off the incline for some time because it was feared they would break through the snow filled crevasses. After the track had become firmly packed and smooth, tractors again resumed operation on the incline but only for towing the Army sled for personnel carrying. After the cable towing device was installed on 20 January 1947, cargo hauling followed this pattern: tractors without track extensions towed loaded sleds from the ships to the base of the barrier; the loaded sleds were then detached and hauled to the top by the cable arrangement; at the top of the barrier the loaded sleds were towed to their destination by tractors with track extensions. Empty sleds were returned to the ships by a reverse process.

d. The track extensions for the D-6 tractors were of oak, 30 inches long, 6 inches wide and 4 inches thick. They were secured to the tracks by two spring loaded C washer type connectors (fig. 106). A ¾-inch carriage bolt through the 6-inch dimension about 2 inches from the inside end of the extension was installed to prevent splitting. The spring loaded connectors did not prove satisfactory. The washers came off, either



Figure 104. D-6 in trouble on bay ice about to be winched out by another D-6.



Figure 105. D-6 in reverse towing three Go-devil sleds each carrying 24 drums of gasoline.

by breaking or sliding off the connectors, within a few hours of operating time. In addition snow tended to pack between the tracks and track extension in such manner as to throw individual track extensions out of line. This resulted in an uneven bearing surface and ultimate breakage. The continuous maintenance thus imposed indicated another means of securing the track extensions to the tracks. Ordinary carriage bolts with a single nut were tried with considerable success. This made the track extensions extremely rigid, lacking the flexibility given by the spring loaded connectors. One disadvantage of the nut and bolt fastening was the difficulty in keeping the nut tight. The natural resiliency of the wood, freezing and thawing of ice between the track and track extension, and the vibration of the tractor caused the nuts to become loosened, when if not retightened they often came entirely disengaged from the bolt and resulted in lost or broken extensions. The extensions were checked and all nuts retightened about every 4 hours. The final solution was to use a lock nut on every bolt. After lock nuts were installed, inspection and maintenance of track extensions was reduced to once each 12-hour shift. Some breakage of extensions

resulted from the rigidity imposed by the nut and bolt fastening in passing over extremely uneven terrain or hard objects buried in the snow. Extreme pressure would thus be placed on one or two individual extensions and resulted in breakage. Sharp and frequent turning, especially on uneven surfaces, placed a great deal of horizontal strain on the track extensions and sometimes resulted in splitting. Track extensions of some type were definitely necessary for the successful

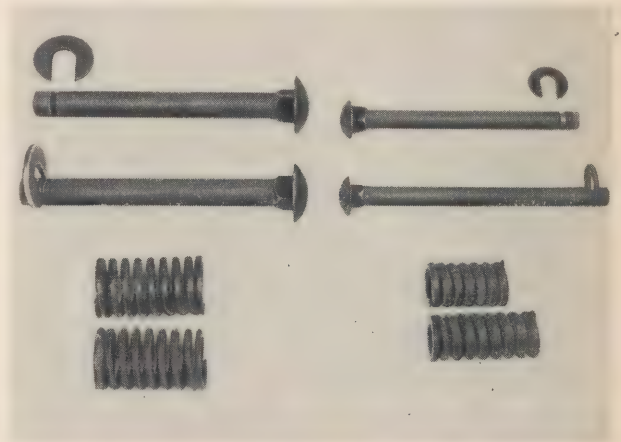


Figure 106. Layout of hardware provided to secure track extensions to tractor. This type of fastener proved unsatisfactory and was replaced by ordinary nut and bolt.

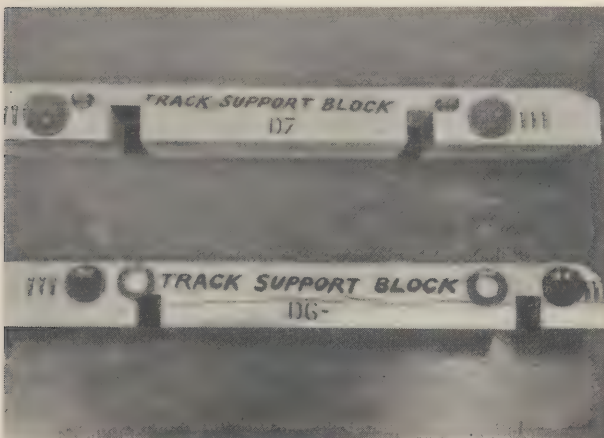


Figure 107. Track support blocks and hardware.



Figure 108. Installation of track support block.

operation of the tractors used on the expedition. The feasibility of a flexible metal type of track extension should be investigated.

8. Track Support Rollers.

The track support rollers were removed from all D-6 tractors prior to leaving the United States. Previous experience indi-



Figure 109. Cle-track (without extensions) in reverse and Go-devil sled loaded with baggage.



Figure 110. Cle-track equipped with extensions.

cated that ice and snow would accumulate around the rollers to a degree sufficient to interfere with efficient functioning of the tracks. Wooden track support blocks were used in lieu of the rollers on all tractors except the Cle-tracks.

9. Engine Starting.

There was no difficulty in starting the engines due to low temperatures. The tractors were never stopped long enough to present a starting problem. During the 15-day cargo unloading phase they were in operation practically 24 hours a day. After the cargo unloading was completed and the tractors were relegated to routine duties within the base camp they were left idling when not in actual operation.

10. Hours of Operation.

Total hours of operation are available on only four D-6 tractors at this time. These four tractors were left in the base camp when the cargo ships left the Bay of Whales on 6 February 1947. The following table shows



Figure 111. Broken track on Cle-track, showing extensions laid out.

the actual hours of operation by these four tractors from 19 January to 23 February 1947:

Tractor No.	Hours of operation	Tractor No.	Hours of operation
4102	505	4059	506
3670	523	4099	520

Average hours of operation..... 514

Average daily hours of operation..... 14

11. Maintenance.

Maintenance on tractors was negligible except for minor adjustments, chiefly on master and steering clutches. The only major failure was one Cle-track which suffered a broken track after a few days of operation and was never repaired. (The Cle-track vehicles were of little value anyway.) Organizational maintenance was performed after each 12-hour shift.

12. Cle-track Tractors.

The three Cle-track tractors (fig. 109) were of the general type found around airfields and used for towing airplanes and general



Figure 112. Abandoned Cle-track. Tools left about equipment in this manner are soon covered by drift snow and lost.

work. They were brought along for similar use around the airfield constructed at Little America. These tractors were seldom used as transportation in the sense of towing drawn conveyances. They did not prove very satisfactory for operation in the snow. When track extensions had been installed (fig. 110) they could tow a loaded 1-ton Army sled, but could not be depended upon to tow a loaded Go-devil sled. After a few hard packed trails had been established some little use was derived from them in towing small pay loads about the camp and airfield. One Cle-track was equipped with all rubber tracks, one of which broke completely in two after a few days of operation and was never repaired or replaced (figs. 111 and 112). These tractors were underpowered and handicapped by being unable to operate at the high speeds for which they were designed.

13. Effect of Temperature and Sunshine.

a. Temperature very definitely affects the consistency of surface snow. For example, when the temperature was above zero degrees Fahrenheit D-6 tractors could not operate on the barrier without track extensions, whereas when temperatures of minus 10 degrees were experienced these tractors could operate quite effectively over the same area without track extensions.

b. Temperature and sunshine also affect the drawbar pull of loaded sleds. On warm, sunshiny days the drawbar pull of a loaded Go-devil sled was considerably less than for the same loaded sled on cold, overcast days. Thus on cold, overcast days, although the tractor itself operated more efficiently, it could not tow as large a pay load as on warm, sunshiny days. No specific data were compiled on this matter but general observations bear it out. In unloading gasoline, for example, the loads placed on sleds would vary by as much as 6 drums due to changes in the weather.

SECTION IV. Drawn Conveyances

1. Types Used.

The following types of drawn conveyances were used:

20 Go-devil sleds.

8 Army sleds, 1-ton.

3 Tank trailers, 800-gallon capacity, mounted on bobsleds.

2. Go-devil Sled.

a. The Go-devil sled was designed and manufactured by the Michler Sleigh and Wagon Company. The sled weighs $3\frac{1}{2}$ tons, has a 10-ton load capacity, and is double ended. It has two runners of wood and welded steel box sheathed construction about 10 inches wide with 3 inches of camber and a center height of 16 inches. The cargo deck is planked with oak timbers 12 inches wide and 6 inches thick, the loading platform being 8 feet wide and $13\frac{1}{2}$ feet long. It is equipped with a chain bridle and a steel

drawbar. The drawbars were never used on this operation, the sleds being towed exclusively by the chain bridle. It has three stake pockets on each side and two on each end. It is altogether a sturdy, well constructed sled (fig. 113).

b. The Go-devil sleds were towed almost exclusively by the D-6 tractors except on the overland trail party to the Rockefeller Mountains when two of these sleds were drawn by LVT's. Go-devil sleds transported the bulk of the cargo unloaded from the ships to the base camp.

c. With an estimated 8- to 10-ton load it was found that the runners cut into the névé of the Ross Ice Barrier sufficiently to permit the cargo platform to rest on the surface, thus materially increasing the drag. On relatively hard packed tracks this did not occur. However, it was discovered that with such a load, even on hard packed snow, this



Figure 113. Attaching towing bridle of Go-devil sled to front of tractor.



Figure 114. Pumping gas from drums to tank trailer. Note ski mounts.



Figure 115. Loaded Go-devil sled and LVT ready for 240-mile trip.



Figure 116. Go-devil sled loaded for trip to Rockefeller Mountains.



Figure 117. Army sled as cargo carrier.



Figure 118. Sideboards added to Army sled keep airplane cameras from falling off in transit.

sled presented a major problem in moving off from a halt because of the runners' freezing to the surface. A D-6 tractor could easily start a sled loaded with less than 3 tons under similar circumstances.

d. During the cargo unloading phase the loads placed on Go-devil sleds averaged 3 to 4 tons each. A typical load was 24 drums of aviation gasoline on each sled. A D-6 tractor could tow two sleds with such a load without difficulty. By reversing the tractor

and towing backward, the D-6 tractor could tow three sleds thus loaded. The loads placed on the sleds were always limited by what the tractors could tow. The sleds could therefore have been of considerably lighter construction for use on this operation.

e. When loaded sleds were being towed down grade and the tractor stopped or slowed down, the sleds would frequently run forward and strike the tractor. The sleds would also swing sidewise and slither

all the way about coming up against the side of the tractor. No damage to tractor, sled, or cargo is known to have resulted from these incidents; however, damage could easily have occurred. It is believed the sleds would have towed much more docilely on down grades had the drawbars been installed.

f. In addition to cargo hauling the Go-devil sleds were used for personnel hauling. As many as 30 men could find accommoda-



Figure 119. Box built on Army sled for personnel protection.



Figure 120. D-6 towing tank trailer.

tion on each sled for the short runs about the area.

g. At the end of the operation all the sleds were in excellent condition and showed little if any sign of wear. With one exception they were used only for local hauling in the immediate vicinity of the Bay of Whales: On the 240-mile round trip to the Rockefeller Mountains one Go-devil sled was towed behind each of the two LVT's (figs. 115 and 116). These two sleds returned in first-class condition.

3. Army Sled.

a. This is the standard 1-ton Army sled designed for towing by cargo carrier M29 and M29C. This sled was used almost exclusively for towing by Weasels. Both as a cargo and personnel carrier it proved to be most satisfactory (fig. 117). These sleds were not used as part of the bulk cargo carrying program. Since the Weasels were used so much as liaison vehicles, they could not be depended upon for scheduled cargo hauling. They were used, however, to haul special equipment and personnel (fig. 118).

b. The Army sled is well constructed and sturdy. At the end of the operation, all



Figure 121. Tank trailer of aviation gas headed for the airstrip.

sleds were still in first-class condition, except for the wooden slats on the cargo platform. A great many of these slats were broken or split. It is not known whether this breakage resulted from overloading, from improper loading and lashing, or from carelessness in dropping heavy items of cargo onto the loading platform.

c. A large wooden box of plywood was built on one sled to shelter personnel while riding (fig. 119). The box was approximately 4 feet wide, 8 feet long, and 5 feet high, closed on all sides except the rear. This box was left on the sled throughout the operation and used in transporting small working parties, especially for the long trip from base camp (Little America IV) to the emergency camp (Little America III).

d. The eye on the drawbar is too small to be attached to the pintle hook of the Go-devil sled. When such an arrangement was desired for the overland trail party to the Rockefeller Mountains, the eye had to be

enlarged. It would be desirable for the eye on the drawbar of the Army sled to be of sufficient size that this particular sled could be attached to any type of pintle hook in common use.

e. The space between the false deck and the slats of the loading platform tends to become packed with snow, thus increasing the weight of the sled.

f. For hauling miscellaneous odds and ends of equipment for short distances without elaborate loading and lashing, sideboards of 2- by 6-inch lumber were built on the sleds to prevent the cargo from spilling in movement (fig. 118).

g. The 800-gallon capacity gasoline tank trailer mounted on skis functioned satisfactorily (figs. 120 and 121). The capacity was not sufficient for refueling the airplanes, therefore it was necessary to tow a sled loaded with gasoline behind the tank trailer and pump from the sled to the tank trailer with an auxiliary pump.

SECTION V. Landing Vehicle, Tracked (LVT)

The following report on the operation of the two tracked landing vehicles used on Operation "Highjump," the LVT3 and LVT4, is based on a report prepared by Marine Corps personnel, submitted to the Commandant, United States Marine Corps.

PART I

Narrative of the Operation of the Landing Vehicles, Tracked, (3) and (4), Operation HIGHJUMP

The Marine detail assigned for the operation of the LVT's on Operation HIGHJUMP was composed of 1st Lt. Roger B. Thompson, M/Sgt. Ralph O. Inman, T/Sgt. George H.

Bigelow, T/Sgt. James L. Thomas, Sgt. Ernest B. Hatch, Sgt. Dwight P. Smith, and Corp. Thomas A. Strock.

One LVT3 was received on 26 November 1946 with the following identification;

Reg. No. C-91676

Eng. No. Starboard—44077

Eng. No. Port—44076

This vehicle had been winterized previous to shipment from storage at Barstow, California. However, the tractor was completely rechecked and it was found that the port batteries and generator were not functioning correctly and minor repairs were made.

The winterization of this particular vehicle consisted of using lighter weight oil (SAE 10)



Figure 122. Checking over LVT the first day ashore.

in the engines, transmissions, oil breathers, air cleaners, and power take-off. The liquid cooling system tested at 60 percent Prestone antifreeze solution and 40 percent water.

Some minor changes were made at Port Hueneme, such as welding steps on the pontoon armor plate, and mounting a Delco Remy "Little Joe" gasoline driven battery charger on the gunner's platform. A tarpaulin was cut to fit the vehicle, and hooks were welded 18 inches apart on the lower outside of the sponsons in order to fasten the tarpaulin down securely to provide at least partial protection during inclement weather.

This vehicle was equipped with one SCR 508 and one TCS radio, plus vehicular spare parts.

On 29 November 1946 one LVT4 was received from Barstow, California, with the following identification;

Reg. No. C-61072

Army No. USA 9139851

Engine No. 46610

Mfrs. Eng. No. 72747

The winterization of it consisted of SAE 10 mineral oil in the engine and air cleaners.

The LVT4 was checked, and some minor work done, such as tightening the push-rod housings, rocker box covers, and the starter

motor, and it was found necessary to reset the gap of all the spark plugs.

Steps were welded onto the sides of the vehicle. The armor plate hatch directly in front of the driver was replaced with safety glass to increase the vision of the driver. Handles were welded on the overhead hatches for ease in opening.

The LVT4 was equipped with one SCR 508 radio, plus vehicular spare parts.

By the 5th of December 1946 both LVT's had been loaded aboard the U. S. S. *Merrick*, the LVT3 being loaded below the main deck in number 3 hatch, and the LVT4 on the square of number 4 hatch. The LVT3 being below decks could not be started during the southward trip but before the temperature reached a freezing point the bilges were drained to prevent their freezing. The LVT4, being accessible, was started and allowed to run for about an hour per week on the southward trip.

A greater amount of time was consumed in traversing the ice pack than had been anticipated, and upon arrival in the Bay of Whales, Antarctica, a period of 6 weeks was left in which to unload the ships, establish a temporary tent camp for 300 men, a per-



Figure 123. LVT4 after unloading cargo. Note how tracks are sunk in snow.

manent 35-man emergency camp, plus an aviation operations center. Since exploratory flights and work allied with them were of such high priority, many lesser projects were necessarily curtailed.

Due to the fact that the LVT's were considered to be an unknown factor, insofar as usefulness in the successful completion of the primary mission was concerned, they were given a low priority, and consequently were not immediately unloaded.

On 20 January 1947, however, the LVT4 was unloaded onto the bay ice in the Bay of Whales, and given a trial run which proved to be quite successful, except that after making two trips to the site of the 300-man temporary camp it was decided that the vehicle was destroying the established routes of travel, especially going up the ramp of the barrier ice. Consequently, an order was given which restricted both LVT's to the vicinity of the bay ice until the unloading of the ships was completed. The snow had practically no crust at this time and was very soft. The machine was operated in second gear except when more power was required.

On 22 January it became necessary to remove the carburetor of the LVT4. The engine had shown a tendency to cut out or misfire on acceleration. This necessitated the raising of the engine at least a foot and one-half, which was accomplished by the use of timbers stacked up alongside the engine overhead opening, and a 3-inch steel pipe reinforced with a steel rod for a crossbar. For a chain hoist, the "track jack" of the LVT3 was used. After the carburetor was removed, it was discovered, as had been previously surmised, that the accelerator pump was not functioning due to having been stored for too long a period, and also that it was the older model which was made of brass, and the metal had become slightly corroded. After completely freeing the com-

ponent parts of the pump, and thoroughly checking the rest of the carburetor, it was replaced, and the engine was remounted in its original position.

Except for some leakage at this time around the rocker boxes and push rod housings, the engine performance and acceleration was very good. This repair, although it sounds quite simple, consumed the better part of 2 days due to adverse conditions and the necessity to avoid frostbite from the combination of cold weather and gasoline.

As much operating time as possible was put on the LVT4 from the 23 January to 30 January, when the LVT3 was finally unloaded. During that time, however, a blizzard and some bad weather limited the operations to some extent.

As soon as the LVT3 was unloaded, and the spare parts had been removed from the cargo compartment, an attempt was made to ascertain the feasibility of ship to shore movement under conditions peculiar to this region.

The air temperature was $+6^{\circ}$ F., and the water temperature was 29.5° F.

A straight edged portion of the bay ice was selected which had a long approach of smooth, snow covered ice. The surface of the bay ice was approximately $1\frac{1}{2}$ feet above the water line. The total thickness of the bay ice varied from 12 to 15 feet.

The transmission selector lever was placed in high range, and the control differential lever in low range. The approach was made at about 10 miles per hour at a right angle to the ice edge. The bow of the vehicle was about $1\frac{1}{2}$ feet lower than the stern at the moment of contact with the water. A slight amount of water was shipped over the bow, amounting to about 1 inch on the deck of the cargo compartment. This water was quickly disposed of by the bilge pumps. No great amount of shock was experienced going into the water.

An attempt was then made to exit from the water onto the bay ice (fig. 124). The approach was made slowly to the straight edge of the ice and on contact the engines were accelerated (fig. 125). This resulted in the tracks' digging into the edge and no appreciable rise was noted in the bow.

A second approach was then made at approximately 6 miles per hour. On this attempt the bow rose up to the top of the ice but the tracks cut into the edge until the hull bellied down (fig. 126). Two more attempts were made and on the third try the bow armor scab caught on the edge at the same time the tractor bellied down, making it impossible to back the vehicle away, or proceed further without aid from an outside source. It was finally pushed off by the LVT4, interposing a 4- by 4-inch timber approximately 22 feet in length between the two machines.

For the fourth attempt, a 50-foot tow cable was used between the two machines, with the LVT4 on the bay ice being used as the prime mover. The LVT3 was towed ahead at about 7 miles per hour with the tracks stopped. On contact with the ice, the towed vehicle applied only sufficient power to the

tracks to maintain contact and reduce drag until traction was gained. The LVT3 came up over the edge due to the tow of the LVT4 (see fig. 127), and when its tracks had traveled less than one-half of their length the vehicle proceeded under its own power.

This test required several hours and no unusual operating temperatures or conditions were noted.

On 31 January during the operation of the tractors on the bay ice a "sinkhole" was encountered by the LVT3 which resulted in rendering the vehicle immobile. The port track went below the surface of the snow some 3 to 4 feet. This caused no particular trouble, and the vehicle was extricated by towing it with the LVT4.

On the second day of February the two LVT's were utilized to transport high explosives from the ship's side to a point about $1\frac{1}{2}$ miles away on the bay ice. To reach the appointed location it was necessary to cross a high pressure ridge and also a tidal crack which was approximately 3 feet wide. Each vehicle carried a pay load of about $4\frac{1}{2}$ tons, and no trouble was encountered.

It was decided on 3 February to conduct another landing test in view of the fact that



Figure 124. LVT3 in the Bay of Whales before attempting to climb out on bay ice in background.



Figure 125. LVT3 approaching bay ice to test feasibility of amphibious ship to shore operation.



Figure 126. LVT3 fails to complete landing attempt and is about to receive a tow.

a better approach from the water was found. A spot was selected which had an "ice foot", or tongue protruding from the front of the bay ice a distance of approximately 7 feet, and at a depth of about $3\frac{1}{2}$ feet below the surface of the water. The top of the bay ice was still about $1\frac{1}{2}$ feet above the water line. The entrance to the water was accomplished in the same manner as in the previous test.

To exit, an approach was made at about 4 miles per hour, and the ice foot was easily attained. The tracks then broke down the top edge of the bay ice and dug in until the



Figure 127. LVT3 is assisted ashore by LVT4.

machine bellied down at an angle of 15 or 20 degrees. The vehicle was then towed out, using the LVT4 as a prime mover. Just enough power was applied to overcome track drag until the LVT3 attained a more horizontal position, when it applied more power and proceeded on its own.

No attempt was made to put any load in the cargo compartment of the vehicle during these tests.

A conference was held during the first week in February by Rear Admiral R. E. Byrd, U. S. N. (Ret), the Base Camp Commander, Commander C. M. Campbell, U. S. N., and his staff. It was determined that an advance weather observation post and emergency aircraft fuel cache in the interior to the southeast was desirable. This was to be at a distance of approximately 300 miles airline from the Bay of Whales, the exact latitude and longitude to be determined by the existing surface condition in the area. Captain V. D. Boyd, U. S. M. C., was designated as leader and navigator for the party to lay the proposed base.

It was decided by Captain Boyd that an attempt should be made to use the LVT's as prime movers for the trip.

On 5 February, due to the scarcity of space on the last outward bound ship, Lt. Thompson was ordered ashore with only two of the original six enlisted personnel in the detail. Taking T/Sgt. Bigelow and T/Sgt. Thomas and the two LVT's, they transferred to the 300-man temporary camp and began preparations for the inland trip.

A 4- by 4-inch ridge pole was secured from the cab aft to the ramp of the LVT3. This had been previously provided in conjunction with the especially cut tarpaulin, thereby roofing over the cargo space for living quarters. (See fig. 128.) The cargo space of the LVT4 was covered over with plywood, and a tarpaulin lashed over it to keep the

drift snow out. A plywood deck was also installed in each vehicle by cutting the plywood to shape and laying it in place. A hatch with a plastic window was installed in the center of the improvised roof just aft of the engine compartment in the LVT4, to permit access to the interior, and also to afford more light in that location. Cooking and eating facilities were installed in both vehicles, using Army "Yukon" tent stoves having downdraft burners. These stoves were quite efficient, and used kerosene as fuel. Gasoline may be used, but it is more hazardous from the standpoint of fire, and is less efficient. Folding cots, mattresses, and sleeping bags were used for bunking.

One of the most difficult preliminary problems, and at the same time one of the most important, was the "swinging" and adjusting of the magnetic compass. Only the LVT4 had a compass mounted, and fortunately it was of a good type. An unsuccessful attempt was made to mount a compass in the LVT3. With a magnetic variation of 104.5° east, plus the steel hull, the magnetic compass in the LVT4 oscillated a great deal. This was due to the weak



Figure 128. LVT3 and LVT4 just prior to departure on 240-mile round trip to Rockefeller Mountains. Note tarpaulin cover roofing on LVT on left.

horizontal component of the earth's terrestrial magnetism in the high latitude of the Bay of Whales area (78° 34' S.). It is generally conceded that the magnetic compass is much too unreliable to be used with safety in the higher latitudes. The magnetic compass in the case of the party under discussion was to be a secondary instrument, since it was planned to navigate with the astrocompass. The astrocompass uses the sun or other celestial body, and as it turned out there was so little sun that the greater part of the trip was navigated by dead reckoning, using the recorded mileage of the sledge-meters, and the magnetic compass in the LVT4. This proved to be quite a problem since the compass oscillated from 15° to 20° to each side of the desired heading.

The cargo for the trip, including the weight of the sleds, amounted to a little over 8½ tons per vehicle. The LVT3 towed one so-called "Go-devil" sled, and the LVT4 one "Go-devil" sled plus one Army cargo sled of 1-ton capacity. The Army cargo sled was fitted with a box to afford personnel protection, and was towed at the rear. One man was stationed in the box, and from this position trail flags were placed at one-quarter mile intervals, to mark the trail for the return trip. The sledge meters were also towed from this sled. Emergency equipment in the way of tents, man-hauling sleds, skis, pack boards, alpine line, portable radio, and cooking gear was also loaded on this sled to be used in the event the party was forced to walk back.

The following medical supplies were taken on the LVT trail trip into the interior:

Medical officer's kit, empty.....	1
Units, plasma.....	3
Units, albumin.....	3
Package, band-aids.....	1
Flashlight batteries.....	1
Foot powder, can.....	1
Tr. Benzoin (4 oz.).....	1

Camphor. Tinct. of Opium, 4 oz.....	1
Sulfathiazole tablets, 7½ gr.....	100
Brandy, 2 oz.....	10
Boric acid ointment, tubes.....	2
Petrolatum, #1.....	1
M. S. syrettes, gr. iss.....	25
Chap sticks.....	12
Tongue depressors.....	12
CO detector ampoules.....	20
Butyn Sulf. 2% and Metaphen, ⅛ oz. tubes.....	4
Mercuric oxide, yellow, oint. ⅛ oz.....	4
Catgut suture, plain #1, tube.....	4
Silk suture, plain #0, tube.....	4
APC tablets.....	100
Phenobarb. gr. iss.....	100
Ammonia ampoules—2 cc.....	4
Ephedrine HCl 1:1000.....	1
Opium and glycyrrhiza tablets.....	100
Cascara sagrada gr. ⅛ tablets.....	50
Cod. sulf. tablet gr. ¼.....	100
Tr. iodine, 10-cc vial.....	6
Tourniquet.....	1
Safety pins, 1 package.....	2
Gauze compress 2-in.....	6
Gauze compress 1-in.....	2
Canvas litter case.....	1
Procaine HCl (syringe type).....	8
Adhesive tape, roll 2 in. by 3 yd.....	2
Pencil.....	1
Needle, surgical, ⅜" curved, cutting.....	6
Needle, surgical, ½" tapered point.....	6
Needle, surgical, ½" cutting edge.....	6
Hypodermic needle #23, 1-in.....	5
Instrument case, pocket, surgical.....	1
Hemostats, 1 plain, 1 rat.....	2
Scalpel, with blade.....	1
Forceps, tissue, toothed.....	1
Shears, bandage.....	1
Clinical thermometer.....	1
Pkg. basswood splints.....	1
Leg splint, Thomas.....	1
Blankets.....	2
Folding litter.....	1
Gauze, plain 36 in. by 25 yd. bolt.....	1
Battle dressings, Carlisle Model (Navy).....	18
Battle dressings, medium.....	2
Bandage, cotton elastic, 3-in.....	1
Triangular bandage.....	3
Splint, wire ladder.....	1
Bandage, gauze, 3-in. roll.....	10
Gauze, compressed, plain 2½ by 2¼ in.....	4
Cotton, absorbent, roll.....	1

Before starting, some tests were conducted to determine the maximum practical load to haul on the "Go-devil" sleds with the LVT's. These sleds had two runners which were double ended, and about 15 feet long. The runners were made of wood, encased in a welded steel sheathing. The width of the runners was 10 inches and center height of 16 inches, with 3 inches of camber. The top was a wood construction of oak timbers, 4 inches thick and 6 inches wide. The total top load area was 13½ by 8 feet. The weight of these sleds was a little over 3½ tons, with a capacity of 10 tons. They were towed by means of a chain bridle made of 1-inch round steel bar, which weighed about 600 pounds.

With a capacity load and an atmospheric temperature of plus 25° F., on a wind packed névé surface, the runners of this type sled sank to the full depth, thus causing the sled to be supported by its top planking. The LVT's were able to tow the sleds in this fashion, but it put a strain on both the sled and the LVT.

When the snow built up in front of the sled in a snow plow fashion, the LVT of course would bog down. The test load was gradually decreased until it was determined that approximately 5 tons would be the optimum load for existing temperatures and surface conditions. This condition was taken to be the most adverse to be anticipated at that particular season of the year.

The trail party personnel consisted of the following:

Captain V. D. Boyd, U. S. M. C., leader and navigator.

First Lieut. R. B. Thompson, U. S. M. C., second in command, and officer in charge of LVT operation and photography.

Major Dan Crozier, U. S. A., medical officer and weather observer.

Chief Warrant Officer A. J. L. Morency, U. S. A., Army observer and assistant LVT driver.

T/Sgt. J. L. Thomas, U. S. M. C., LVT4 crew chief and maintenance.

T/Sgt. G. H. Bigelow, U. S. M. C., LVT3 crew chief and maintenance.

T. W. McGovern, Aviation Radioman Second Class, U. S. N., communications.

The party was divided into two groups. Lt. Thompson, Sgt. Bigelow, and Radioman McGovern were assigned to the LVT3; Captain Boyd, Major Crozier, Mr. Morency and Sgt. Thomas were assigned to the LVT4.

The LVT3, as previously stated, was equipped with a TCS radio in addition to the standard SCR 508 radio, and was the only means of communication with the base camp. Fortunately the TCS was very satisfactory, although beyond a distance of 50 miles the whip antenna had to be replaced by a Marconi type dipole antenna cut to length for frequencies of 6430 and 4125 kilocycles, and having a horizontal wire of equal length as a counterpoise. (All radio antennae in the Antarctic must have a counterpoise since there is no ground near the surface of the ice and snow.) The boathooks of the LVT's were used as masts for the antennae. Communications were conducted mostly by



Figure 129. LVT's return after successfully completing 240-mile trip.

“CW”, as beyond 35 miles voice contacts were unreliable. The SCR 508 radios had been expected to be very useful in intervehicular communications, but actually proved to be useless due to the high noise level, and also the fact that several weak tubes showed up after departure from the camp. It was also noted that the microphones had a tendency to freeze due to breath moisture. It was difficult to use the ear phones as the particular type headgear issued was not fitted for them, and it was too cold to do without headgear. For intervehicular communications, standard arm and hand signals were finally reverted to and were found satisfactory.

The vehicles traveled in echelon the entire trip (fig. 129) to avoid breaking through the natural snow bridges of crevasses, which may have been weakened by the first vehicle crossing them.

The party departed on 12 February on the first leg of the journey to the Rockefeller Mountains, in King Edward the VII land, approximately 123 land miles to the east. The temperature was $+20^{\circ}$ F., and the snow surface smooth but fairly soft. The tracks of the vehicles cut in to a depth of about 10 inches.

The first day 22 miles were logged, with frequent stops to check the course due to the lack of sun and zero visibility. A so-called “white” condition prevails under overcast conditions in the Polar regions due to the lack of a horizon to contrast one’s surroundings. The effect is similar to being suspended in a bowl of milk. This makes travel hazardous, and bearings extremely difficult to maintain, particularly in the absence of any landmarks such as mountains. Under such conditions, a yawning crevasse may be driven into without any foreknowledge of its presence. It was also possible to drive headlong into huge snowdrifts or “sastrugi.”

It was on the first day’s travel that the LVT4 showed evidence of using an excessive amount of oil (7 gals. SAE 20 in 22 miles). However, the oil was not being burned, but “thrown” out through various joints and connections, such as the rocker box covers, and the push-rod housings. The oil pressure and temperature readings remained normal, so the condition did not cause any great alarm, but was a particular nuisance under the prevailing conditions.

The visibility was still very poor on the second day, and the temperature $+8^{\circ}$ F. The surface was quite soft, and the LVT3 became bogged down. (This was never definitely ascertained but it is believed that this was a “bridged over” crevasse.) It had to be towed out. In general it was rather heavy going. On this day’s run the party reached a position 66 statute miles east of the base. By this time it was estimated that the distance the LVT4 could travel would depend upon the available oil supply.

The third day out the average temperature had dropped to -10° F. The surface snow was soft and fluffy, and about 10 inches deep. However the decreased temperature had hardened the undersurface, and travel was much easier.

Visibility improved, and several good sights were taken with the astrocompass to check the course of travel. The engine of the LVT4 was using about 1 gallon of oil for each $2\frac{1}{2}$ miles made good. Attempts were made to improve this condition with the limited quantities of SAE 30 and SAE 50 oil on hand. These attempts were not highly successful.

At 1300 on this day (15th of Feb.), the western end of the Rockefeller Mountains was reached. A distance of 108.6 statute miles was registered on the sledgemeters. A large crevasse was hit at this point by the LVT4, which was in the lead. It crossed safely due to its long tracks. The snow bridge over the

crevasse was crushed down, but did not break all the way through, so that the sleds were also towed safely across. The width of this crack was about 10 feet from wall to wall. A shorter vehicle would have undoubtedly crushed through this crevasse, even though it may have been lighter in weight.

The fifth actual day away from the base being Sunday (16 Feb.), no travel was made. However, the day was spent giving the engine of the LVT4 a thorough inspection and tightening up. Particular attention was paid to the push rod housing, bushing nuts, and check nuts. These were found to be very loose, and upon tightening them, the packing was found to have deteriorated to the point where it was practically useless.

All hands had a badly needed wash and shave. Visibility being extremely good, bearings were taken on several known mountain peaks, using the astrocompass, and the position was definitely determined.

A complete reorganization of gear was made both on the sleds and in the tractor cargo spaces (living quarters). Captain Boyd and Major Crozier built entire new bunking facilities in the LVT4. Using available lumber and the standard government cots, double bunks were constructed along the bulkheads of the rear of the cargo space for four men. This gave an added amount of space just aft of the engine and produced a much more comfortable atmosphere, in spite of the film of oil smoke which adhered to the clothing and bedding. With the exception of Mr. Morencey, no one could stand upright in this improvised living compartment because of the low overhead.

At this point of the trip a dispatch was received directing the party to return to the base camp, and informing them that the flight plans had been changed. Instructions were requested concerning the laying of an emergency cache at the base of Mt. Helen

Washington, a few miles farther on, and an affirmative was received. During the night the temperature dropped to -25° F.

The party departed at 2240 of the 17th for Mt. Helen Washington and arrived there at 0100 of the 18th without incident. The LVT4 was still using an excessive amount of oil. The distance traveled to this point was 123.6 statute miles. The cache of aviation gasoline, food, and emergency equipment was established. This cache was marked by a large red flag secured to the upright end of a piece of 4- by 8-inch lumber approximately 20 feet in length.

After the cache was laid, the entire party boarded the LVT3 for a trip to the top of Mt. Helen Washington, which rises to an altitude of over 1,800 feet. The purpose of this trip was to collect geological samples, and to test the reaction of the vehicle on the hard ice of the glacier. The ascent was made in second and third gear with the transfer case in low range at an average speed of about 7 miles per hour. No difficulties were encountered in the ascent of the glacier. Near the very crest of the slope where the glacier ice joined the "fast ice" of the mountain, there existed a large crevasse covered by its natural bridge. The vehicle crossed this unseen crevasse, due to the length of the tracks, with only a good bump. It was not until the driver went back to investigate what caused the bump that the crevasse was discovered for its true size, being approximately 10 feet across and of unknown depth.

A side trip was made across the face of the glacier to Mount Franklin, about 1 mile west of Helen Washington, to visit the site of a seismographic station established in 1940 by the U. S. Antarctic Service.

At 0440 (18 Feb.) the party departed from the base of Mt. Helen Washington for the return trip to the Bay of Whales, and at 0900 arrived at the 88-mile depot of fuel and food

which had been laid on the way out. Upon arrival at this point all hands turned in. At 2245 (18 Feb.) the party departed for the final run to the base camp at the Bay of Whales. This run of 88 miles was accomplished in 17 hours, stopping only to pick up fuel which had been cached on the outward trip. It will be noted that much better time was made on the return trip. This was due in part to the fact that the party was retracing the original route under conditions of good visibility, and no stops had to be made for checking the course.

The round trip totaled 245 statute miles. The LVT3 consumed 430 gallons of 72-octane gasoline and 2 quarts of oil; the LVT4, 480 gallons of 100-octane gasoline and 80 gallons of oil. The suspension systems were both serviced after 45 hours of operation. The engine and power train on the LVT3 was checked and serviced every day and on long runs sometimes 2 to 3 times per day in order to avoid any major trouble. However, the right angle drives, control differential, and final drives used no oil during the entire trip. The LVT4, because of the leakage of oil in the engine, required constant attention and frequent additions of oil.

On 23 February a trip from the base camp to the point on the bay ice where the U. S. S. *Burton Island* was moored, was attempted. Carrying 12 people the LVT3 successfully crossed the then enlarged crevasses in the "Barrier Ramp," but in attempting to cross a tidal crack in the bay ice the vehicle crushed through the rotten edges and wedged itself into the crack (fig. 130). Had this vehicle not been of the amphibious type, it is quite certain it would have gone through the crack and sunk with all hands. While floating in the water it was impossible for the tractor to gain sufficient traction on the ice to pull itself out without some outside help. Using a D-6 bulldozer as a "deadman," two 50-foot lengths of 1-inch cable were attached



Figure 130. The LVT3 crushes through rotten edges of tidal crack in bay ice.



Figure 131. Practically clear now and going strong.



Figure 132. LVT3 now safe on bay ice 10 to 15 feet thick. Note broken ice where vehicle was floating. Pressure ice in right foreground locates trace of crevasse (tide-crack).

(fig. 131) one to each LVT track, and run out to the "deadman." With this source of traction and using reverse power, the LVT was slowly backed out under its own power (see fig. 132), the tracks acting as winches. This method is recommended only when the obstruction to be surmounted is not of sufficient height to cause the vehicle to tip beyond the point of balance.

Various methods have been improvised to increase traction of these particular vehicles in difficult circumstances depending, of course, on the conditions involved.

The two LVT's were secured for storage on 23 February 1947 at the emergency base erected at the site of Little America III referred to as West Base Camp of the U. S. Antarctic Service Expedition of 1939-41.

PART II

Recommendations and Conclusions for the Improvement of Landing Vehicles, Tracked (LVT's) for Polar Use

1. Introduction.

It is pointed out that this report on the performance of the LVT's is based on work which was executed at the beginning of the most advantageous season of the year in the Bay of Whales area. From the last of January to the first of November, the temperature is sufficiently low to harden the surface and the subsurface of the wind-packed névé snow, which facilitates the operation of tracked vehicles. In general however, vehicles may be required to operate over a wide variety of surface conditions in the Antarctic. The surface may vary from extremely hard ice to névé snow, which is quite comparable in consistency to coarse beet sugar. Under certain conditions it will not take any compaction, and compaction is generally attained only after long arduous

efforts have been expended over a given area. Under normal conditions the névé snow found in the Polar regions is capable of supporting a load of only a few pounds per unit of area. The surface may be very smooth, or it may at times be broken up by hard ridges of wind packed snow called "sastrugi." These ridges vary in height from a few inches to several feet. They generally run parallel, and indicate the direction of the prevailing wind. The height and spacing of sastrugi may vary with existing wind conditions from hour to hour, or day to day depending on existing meteorological factors.

2. Lubrication and Fuel.

a. The LVT3 was winterized and maintained with the following lubricants during the entire operation: SAE 10 oil in the engines, transmissions, oil breathers, air cleaners, and power take-off. SAE 50 oil in the right angle drives, control differential, and internal final drives. The fuel used was 72- or 80-octane, depending on availability. No difference could be noted in performance between the two ratings.

b. The LVT4 was winterized with SAE 10 oil in the engine and air cleaners. The transmission, differential, and internal final drives were filled with SAE 50 oil. The fuel used in the engine of this vehicle was 100-octane aviation gasoline.

c. The totals of fuel and lubricants versus hours of operation for the LVT's 3 and 4 are as follows:

	LVT4	LVT3
Engine hours	149 hrs. 30 mins.	131 hrs.
Vehicle hours	109 hrs. 50 mins.	95 hrs.
Fuel	1,400 gals.	880 gals.
Lubricating oil	146 gals. . .	2 qts.
Grease	10 lbs.	5 lbs.
Average fuel consumed per hour.	9.37 gal. . .	6.72 gals.
Average oil consumed per hour.	.97 gal . . .	.0153 qt.

d. No trouble was encountered with the grease seals on either tractor, and from that standpoint both vehicles were entirely satisfactory. However, it is recommended that low temperature nonchanneling types of grease be investigated for future cold weather operations.

3. Rubber Components, Reliability and Weaknesses.

Very few difficulties were encountered with either the LVT3 or the LVT4 insofar as the rubber components were concerned. Elasticity was well retained in the various rubber components of the suspension system. In the LVT4, however, due to the fact that the oil used was light weight, the neoprene seals of the "rocker boxes" and push rod housings failed and subsequently allowed a great deal of oil to escape from those particular places. In the LVT3, the only noticeable change to rubber was the watertight covering over the starter switches on the control panel, which became so stiff at times, they required some type of blunt instrument to depress them.

4. Power Train.

a. *Starting and Operation of Engines.* (1) As has been previously stated the temperatures encountered on this operation were not the extremes that might be expected at other times, and as a consequence little or no difficulties were experienced, especially with the LVT3. The LVT4 was being operated with a lighter weight oil than is customary or recommended and consequently gave no particular trouble in starting.

(2) It is believed that should the LVT type vehicle be employed for extended periods in frigid zones, some type of engine preheater would be very necessary.

(3) The Herman Nelson type of preheater is highly recommended, principally for the LVT3, since due to the construction of the

vehicle the entire power train could be quickly and efficiently heated, thereby reducing the possibility of breakdowns in the field which would undoubtedly be encountered should the forward portion of the power train be operated on standard weight oils without sufficient "warming up."

(4) Operator fatigue from constant gear-shifting in the LVT4 was experienced, in traversing rough, wind-blown surfaces or "sastrugi."

(5) The particular engine of the LVT4 did not perform satisfactorily in relation to oil consumption; however, this was possibly due to the fact that it was a reconditioned engine, and had obviously been in storage a long period of time. Aside from the engine of the LVT4 no repairs were found necessary.

(6) The LVT3 performed extremely well throughout the expedition with only minor adjustments to the engines, and no repairs to the remainder of the power train. The carburetor "butterfly" valve on the port engine froze on one occasion, but required only a short time for freeing, and caused no damage or trouble. The tachometer flexible drive shaft parted, and although repaired (brazed), it parted again when the vehicles were out of range of any facilities. This, of course, prevented keeping the engines synchronized as well, perhaps, as they should have been, but caused no inconvenience or breakdowns.

b. *Electrical and Ignition Systems.* (1) No difficulties were experienced with the ignition systems of either type of engine, with the exception of one magneto on the Continental engine of the LVT4. It gave no serious trouble and still functioned in spite of being weak.

(2) Storage batteries functioned as any storage battery will under cold weather conditions. A fully charged battery will not freeze at sub-zero temperatures, but an uncharged one will freeze at about $+5^{\circ}$ F.

The efficiency of storage batteries drops very rapidly at sub-zero temperatures, and at a solution temperature of -30°F . the battery becomes practically useless. At a solution temperature of $+35^{\circ}\text{F}$. the battery will not accept a charge efficiently. Because of these factors, the batteries of the LVT3 required frequent chargings. The drain on them on the starboard side was very heavy due to the command radio equipment installed in the vehicle. It is recommended that in operations of this kind, when additional radios or electrical equipment are installed, the installation also of an auxiliary gasoline driven charger be made.

c. Engine Cooling and Personnel Comfort. (1) The air cooling system of the LVT3 is not suitable for Antarctic or Arctic use as it now stands, principally because of the personnel factor. In damp climates this could prove to be not only uncomfortable, but highly injurious to the operating personnel. As it is now equipped, the source of air for the cooling of the entire power train is in the direct vicinity of the driver of the vehicle. This, combined with the comparative inactivity of the driver during long hauls, will definitely decrease efficiency of personnel, and in time even incapacitate them.

(2) It is recommended that the area in the vicinity of the driving compartment be sealed from air blast under the driver, and some type of outside adjustable air ducts for a source of air be incorporated in the LVT3 for this particular type of work. Other minor installations would be necessitated in conjunction with this, such as defrosters on the vision ports, etc., but it is believed they would be relatively minor in scope.

(3) The above change would facilitate the closing in of the vehicle in order to make it a livable machine, in the event it might be used for living quarters, hospital evacuation vehicle, and other uses of a like nature.

5. Track and Suspension Systems.

a. Mechanically the track and suspension systems of both vehicles functioned very well except that a wider track will be necessary in order to transport a load approaching maximum. For soft snow as well as the thick bottomless mud encountered in the northern regions, the surface bearing pressure must be reduced in order to operate the machine with dependability. Two to four pounds per square inch of bearing pressure with the vehicle loaded to capacity, would be the ideal for all types of snow operation in the Antarctic regions with the LVT's.

b. Due to the conditions encountered in the area, one of the most difficult problems relative to the track and suspension system was the packing in and building up of snow and ice under the tracks along the top surface of the pontoons. This caused immobility of the support rollers to the extent that the forward support rollers on both sides of the LVT3 froze, and were worn flat within about 1 hour. The necessity to clear the suspension system completely at every available opportunity was not overlooked, but the above incident occurred during an interval between stops. There was also a noted amount of congestion around the return idler wheel, which caused an excessive but not a hazardous amount of wear to the rubber tires.

c. The grousers on both types of tracks (LVT3 and LVT4) were constantly being packed with snow which would turn into hard ice due to the friction of the track and to the constant digging motion of the track into the surface. It was necessary to chip this ice out of the grousers frequently to prevent loss of traction.

6. Hull and Components.

a. The hull, basically, is the closest approach to the type of vehicle needed for this use to be found in any of the present day military vehicles, but for a strictly cargo

carrying vehicle it still needs to be lightened as much as possible. This can be done to some extent by the removal of all scab armor, but to obtain maximum efficiency a further reduction in vehicular weight would be highly desirable. It is recommended that the possible incorporation of some type of aluminum alloy be investigated to further reduce the weight of the LVT.

b. In cold climates and under adverse conditions, an electrically operated ramp winch is highly desirable. This will not only save labor, but reduce the time needed for the raising of the ramp to a remarkable degree.

c. If engine preheaters are installed in the LVT's, it would be necessary to insulate the engine compartments, in order to maintain efficiency.

d. Drain plugs for the crankcase and transmissions should be made more accessible. A man wearing heavy cold weather garments finds it very difficult to gain access to these points, as well as the engine itself. In view of this it is recommended that some means be provided whereby the engines would be made more accessible. Inspection plates on the outboard sides of the engines, or a type of sliding tray unit for the engines would serve this purpose.

e. In line with modifications on the present LVT3 for Arctic or Antarctic use, it is recom-



Figure 133. LVT running a surface penetration test.



Figure 134. Keeping track and rollers free of ice and snow is important in the Antarctic.

mended that the possibility of a pre-set friction type clutch arrangement on the power bilge-pumps be investigated. Although no trouble was encountered, it was only because great caution was exercised to prevent it. If the vehicle has been operating in water, and then allowed to stand idle only for a short time, it is very possible that water could freeze in the bilge pump and render it useless if the engines are started.

7. Navigational Gear.

a. Because of the difficulty to be experienced with the magnetic type compass in the higher latitudes, it is recommended that the installation of a gyrocompass of a non-precessing type be investigated.

b. It is also recommended that consideration be given to the installation of some type of odometer to be used as an aid in navigation over unmarked and unknown land or ice, for extended journeys.

8. Tools and Equipment.

The tools with which the LVT's are ordinarily equipped are usually quite adequate, but when a small detail is sent out as an independent unit, some additional fifth echelon tools would be highly desirable. Also, for this type of use the pioneer tools should be added to.

9. Conclusions.

a. This report and the recommendations are not to be construed as condemning the Landing Vehicle, Tracked. It already has proven itself in the various fields for which it was primarily designed. Now it shows tremendous possibilities in another environment.

b. In its present form the LVT is not the ideal vehicle for Polar use. It is far too heavy per unit of area on its tracks. Furthermore, there is very little personal comfort insofar as the operator is concerned. Reliable engine starting, due to the lack of engine preheating devices, would also cause considerable concern at low temperatures. In spite of these and many other faults, the vehicle is basically the best military vehicle available for carrying cargo, and to act as a prime mover for extended operations over a polar surface a great distance from a base.

c. From a military standpoint, there are requirements for two distinct types of these amphibious vehicles for polar use:

(1) One type to be used for cargo handling.

(2) A combat type, armored and carrying weapons, or troops.

From these might be evolved vehicles designated as mobile machine and repair shops, hospital units, administrative units, and many others requiring great mobility.

d. Based on experience, the full track laying, front wheel drive type of vehicle is superior in snow covered areas. From this may be drawn the conclusion that if the vehicle is suitable for snow conditions, it also would be suitable for swamps and/or hard surfaced roads.

e. The recommendations in summary in view of these tests are as follows:

(1) Increase the width of the tracks.

(2) Modify the engine cooling air intake method.

(3) Manufacture a removable cowling or roof.

(4) Install a nonprecessing gyro type compass.

(5) Modify the suspension system for the clearance of ice.

(6) Install a friction clutch on the bilge pump.

(7) Install inspection plates on outboard sides of pontoons.

(8) Install engine preheaters.

The above recommendations are concerning the LVT3. It is further recommended that with the present type power train, the LVT4 should not be used to any extent in the regions of higher latitude.

SECTION VI. Observations

1. Maintenance.

a. Organization. The motor vehicle maintenance establishment at Little America consisted of 1 warrant officer, 1 chief petty officer, and 10 mechanics. Maintenance was carried out during the cargo unloading phase on

a 24-hour-a-day basis in two 12-hour shifts. The warrant officer and 5 mechanics comprised one shift and the chief petty officer and the remaining 5 mechanics comprised the other shift.



Figure 135. Maintenance work on carburetor being performed in open.

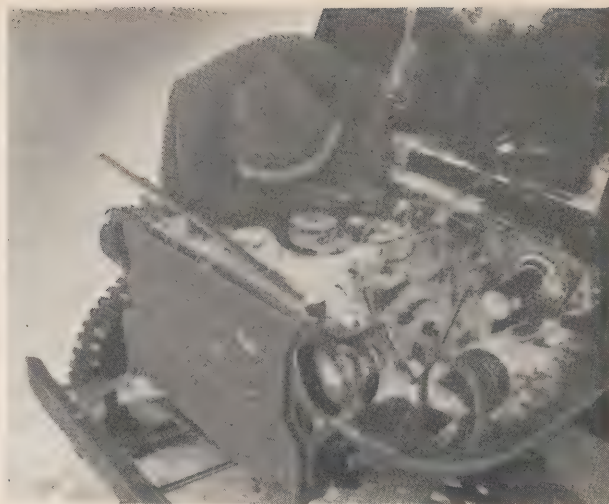


Figure 136. Jeep engine after blizzard.

b. Equipment.

- 1 Battery charger, powered with a small gasoline engine.
- 1 Greasing unit (Lincoln) mounted on a $\frac{1}{4}$ -ton trailer, trailer mounted on skis.
- 1 Welding unit (Hobart) 300-amp.; powered by a Chrysler gasoline motor, unit mounted on skis.

A normal complement of hand tools.

No grease racks or pits were constructed.

c. Housing. (1) From 19 January 1947 until 6 February 1947 the motor pool and maintenance shop was located at the base of the barrier near the lower terminal of the cable towing device. When the cargo ships left the Bay of Whales the motor park and maintenance shop were moved to the base camp on top of the barrier.

(2) At the first location the only shelter was one pyramidal tent with an oil heater and a wooden floor. This tent served as a combination maintenance shop, dispatcher's office, and headquarters of the transportation officer. All maintenance work on vehicles was performed in the open (figs. 135, 136, and 137). As the weather was relatively mild during this period no hardship on per-



Figure 137. Maintenance on track extensions performed in open.

sonnel occurred. The temperature never went below zero degrees Fahrenheit during this period. Much of the time delicate work could be performed barehanded for short periods of time without danger of freezing the hands.

(3) At the second location in the base camp the housing consisted of one pyramidal tent with an oil heater and wooden floor, and one wooden shack, approximately 20

feet by 10 feet, with a wooden floor and a canvas roof. The tent was used as headquarters of the transportation officer and as a dispatcher's office. The shack was heated by an oil burner and served as a tool shed and as shelter for vehicles requiring maintenance. During this phase the weather began to turn colder. The lowest recorded temperature was -23° Fahrenheit. Hence, the very definite need for a sheltered area in which to perform motor maintenance. A large shelter, closed and heated, and capable of housing the largest type vehicle in use is desirable for maintenance activities.

(4) At no time was any provision made for housing parked vehicles, even to the extent of covering them with tarpaulins. It would seem desirable to provide housing for vehicles if time, material, and labor are available for construction, which was not the case on this operation. However, the tractors, Weasels, and LVT's did not suffer any apparent ill effects from being in the open and constantly exposed to the elements; whether this would hold true during the winter season is questionable.

d. Spare Parts. Spare parts were limited to those of first and second echelon nature. No major replacement units were provided. Lack of replacement for major units permanently deadlined only two vehicles: A Weasel and a Cle-track, both with broken tracks. It is recommended that a number of replacement units of third echelon nature be included in the supplies of any Antarctic operation.

e. Conclusions. The personnel and equipment seemed adequate to maintain properly the vehicles used in the operation. The lack of replacement units did not seriously impair efficient maintenance as it turned out. The chief maintenance problem was in keeping the track extensions of the tractors properly secured to the tracks. Otherwise maintenance was for the most part limited



Figure 138. Unmarked cache.

to minor first and second echelon adjustments and repair.

2. Storage of Fuels, Oils, and Lubricants.

a. Containers. Included in the ships' cargo and hauled to the top of the barrier for storage were hundreds of drums of fuels, oils, and lubricants. These included gasoline for motor vehicles and airplanes, Diesel oil for the tractors and stoves, and other miscellaneous petroleum products. These drums were all properly marked according to their content, the markings also signifying the location of the cache in which they were to be stored. This type of marking is essential for Antarctic operations, because eventually all cached supplies are covered with snow, often to a depth of several feet.

b. Caches. A recommended method for caching petroleum products is to line the barrels up on end in a double row with a

12-foot pole stuck into the snow at each end of the row. The top of each pole will be so marked as to identify the one particular type of supplies cached, "72-octane gasoline" for example. Then if the cache becomes covered the poles will stick up out of the snow with the proper identification. Thus a detail looking for 72-octane gasoline can readily locate same by digging down at one end of the row. After taking out the required number of drums the detail should then move the marking pole over to the new end of the row and the cache will still be properly marked and located for the next detail. Some of the petroleum caches on this operation were not stored and marked in this fashion (fig. 138).

3. Tarpaulins.

a. The trail party which made the trip to the Rockefeller Mountains made some interesting observations on the use of tarpaulins to protect the cargo of towed sleds. Initially heavy tarpaulins were spread over the cargo and lashed securely down as protection from snow. It was soon discovered that some snow would find its way under the tarpaulins on the trail in spite of every method of lashing. The rays of the sun reflecting from the tarpaulin would frequently melt the snow which collected on the tarpaulin, eventually resulting in ice. This freezing made the

tarpaulins extremely difficult to handle. It frequently required two men from a half hour to an hour to roll back the tarpaulin in order to get at the cargo, or to readjust the tarpaulin over the load. The trail party made frequent stops to cache supplies. The difficulty encountered in handling the heavy, frozen tarpaulins soon discouraged their use and the tarpaulins were folded up and carried as cargo.

b. It is recommended that some light, strong, water-resistant canvas be used in lieu of heavy tarpaulins for protecting loaded sleds, especially if the load must be gotten at frequently. The feasibility of installing brackets and bows on sleds to support a cover similar to that of a cargo truck should be investigated.

4. Dogs and Dog Sleds.

No report on transportation in the Antarctic would be complete without some mention of dogs and dog sleds. Twenty-seven dogs and four dog sleds were placed ashore at the Bay of Whales. The dogs did not play an important part in the operation, although they might have proven invaluable for rescue work had circumstances so required. Actual use of the dogs on Operation "Highjump" was generally limited to lending atmosphere and hauling seal meat for use as dog food.

SECTION VII. Recommendations

1. General.

a. The question arises as to whether standard construction or military vehicles should be used, with modification in some cases, or whether specialized vehicles should be designed for transportation in the Antarctic or in areas where similar conditions are encountered. All vehicles used on Operation

"Highjump" were standard construction or military vehicles. Of these, only the Weasel and LVT's were able to operate satisfactorily under all conditions without modification. Observations indicate that some standard construction or military vehicles can be modified so as to operate efficiently in the Antarctic without drastic changes in design.

b. It is recommended that the following general requirements be considered in the design of any vehicle for use in the Antarctic:

(1) Heavy duty prime movers capable of moving heavy loads of cargo on sleds for long distances. These vehicles should provide living accommodations for the normal operating crew.

(2) Heavy duty prime movers for short, local hauls.

(3) Light duty, fast vehicles for moving small quantities of material and personnel and for liaison and reconnaissance service. This type of vehicle is required in several sizes, roughly to fulfill the duties performed by the ¼-ton truck, the command and reconnaissance car, and the scout car in normal ground operations.

(4) Ability to operate on snow and ice is the prime consideration for vehicles in the Antarctic. A few isolated mountain peaks project through the icecap; otherwise the entire interior is covered with ice or snow except for limited areas on the Palmer Peninsula which are relatively free of snow during the summer season.

c. It is recommended that the following technical requirements be considered in the design of vehicles intended for use in the Antarctic:

(1) Tracklaying vehicles are the only type of mechanized vehicle suitable for use in the Antarctic.

(2) The maximum length of track bearing surface consistent with the size and weight of the vehicle is required for smooth operation over uneven surfaces and to enable the vehicle to cross crevasses.

(3) The drive sprockets should be in front to provide the most efficient operations.

(4) Width of the tracks should be such that the ground pressure per square inch is less than 3 pounds.

2. Wheeled Vehicles.

No wheeled vehicles should be considered for transportation purposes in the Antarctic.

3. Cargo Carrier, M29C (Weasel).

a. A longer track is required for smoother operation over uneven terrain and to facilitate crossing crevasses.

b. The feasibility of front wheel drive should be investigated.

c. The feasibility of individual track blocks with connectors should be investigated.

d. If the vehicle is not to be used amphibiously, doors should be cut into the hull for easy access and an enclosed body provided for passenger comfort.

e. The feasibility of replacing the present type spring with volute springs should be investigated.

f. The space between the right steering brake lever and the engine cover should be widened to permit easy access to the foot throttle when wearing heavy boots or shoes.

4. Tractors.

a. The length of the tracks should be increased to facilitate travel on rough or crevassed areas.

b. The width of the tracks should be increased to decrease the ground pressure per square inch to 3 pounds or less. If increasing the width of tracks is accomplished by track extensions, the feasibility of a flexible metal extension should be investigated.

c. The support rollers should be replaced by a plate or wooden block to prevent snow and ice building up in the track mechanism.

d. Ice type grousers should be used on all tractors in the Antarctic.

e. Cabs should be provided to protect the operator.

f. Each tractor should be equipped with a winch.

g. In some instances an independent niggerhead would be desirable.

h. The feasibility of front wheel drive should be investigated. All tractors on Operation "Highjump" performed more efficiently in reverse.

i. The present power plant appears to be satisfactory.

5. Sleds.

a. The Go-devil sled should be higher off the ground to allow more clearance when operating in soft snow.

b. The Go-devil sled could be considerably lightened for an operation like "Highjump".

c. The loading platform of the 1-ton Army sled should be improved. The present slats should be sturdier or else replaced by a solid deck.

6. Landing Vehicle, Tracked.

a. All surplus weight should be removed. Armor plate, for example, is unnecessary (military operations excepted). If not to be used amphibiously the hull could be lightened.

b. The perforations now let into the front of the driver's compartment to cool the differential should be eliminated and an



Figure 139. Jeep almost snowed under by a blizzard.

air scoop installed with a duct leading direct to the differential. The present system makes the driver's compartment uncomfortably cold.

c. A windshield should be installed in the vision hatch of the driver's compartment and the windshield equipped with a defroster.

d. The tracks should be widened to decrease the ground pressure per square inch. A 24-inch track should be satisfactory.

SECTION VIII. Comments by U. S. M. C. Observer

Captain Vernon D. Boyd, U. S. M. C., who was in charge of transportation operations ashore and is a veteran of two previous Antarctic expeditions, made the following comments on transportation, vehicles, etc.:

1. Types Required.

From the standpoint of transportation the job must be divided into two general types or classes. We must be constantly aware of the fact that we must have transportation which can be used in small areas, plus trans-

portation to be used for handling heavy cargo over long distances. By small areas is meant that transportation be available that can be used to handle cargo and possibly personnel in rather limited space—for instance, alongside a ship tied up at a dock or in the case of the Arctic regions, possibly a ship unloading direct onto ice. After an operation of this type is accomplished and the materiel has been unloaded by smaller types of transportation, to get it into the interior we must have a larger machine

which must be used for more than one purpose. In the first class of machines, that which would be used over small distances, we would probably use tractors of the present commercial type and design similar to the D-6 class of caterpillar. I would not, however, recommend anything larger than the D-6, as that appears to be about the largest that can be used on the snow surface. Also, it must have certain track modifications to be used on any type of snow surface. Secondly, the machine which is most adaptable for long-distance cargo and personnel handling will be a tracked vehicle of the type which the Marines used in the Pacific called the Landing Vehicle, Tracked, or LVT. This is strictly a cargo vehicle and has a hold which makes it a small boat. Therefore, it can be used as an amphibious vehicle, and it can land from shipside with cargo or with personnel and make landings on beachheads, etc., and go on into the interior. For snow operations, however, as with all the other vehicles which we presently have, it must have some modifications to make it more adaptable.

2. Vehicle Track Modifications.

In regard to modifications, the width of the track seems to be the greatest problem. We have quite a number of vehicles that might be suitable, while not necessarily ideal, but due to the narrowness of the track they present a very great problem. This has been partially overcome by application of various modifications to make them wider. During the war we used extended end connectors on our tanks and vehicles of that type to give them a greater area of spread on the ground to hold the weight. These will work, but they are merely expedients. Tracks to be used in polar areas must be wider. We have tried to modify the tracks of commercial vehicles by the application of planks bolted through on the grousers and on the ground

plates to make them wider. It works but it is not satisfactory. We must go into machines of wider tracks.

3. Front Versus Rear Drive.

Another thing that is very common, particularly in the commercial type tractors, is the fact that they all have rear wheel drives. There are many arguments pro and con about this, but through years of operation on snow surfaces, and in my own experience, it was found that the rear wheel drives were the more impractical type, due to the fact that the machines build up a torque component on the rear axle which forces the rear of the tread down into the soft snow and the front of the machine up into the air. The rear end consequently digs itself down in. We have made some experiments in building platforms on the front end of the machine and loading them down with a couple of tons of coal to hold the front end down, but we still had the same results. We tried passing cables underneath the tractors and taking the drawbar pull from the front of the machine, thinking we could hold the front end down that way. That was not successful. It appears, on the surface at least, that the front wheel drive is really the only answer to vehicles for soft snow surface transportation.

4. Track Loading.

In the matter of track width the practical load limits in pounds per square inch run from a minimum of about 2 pounds per square inch to an absolute maximum of 5 pounds per square inch. When 5 pounds per square inch are exceeded then difficulty may be expected, as the machines seem to bury themselves, especially if they have the rear wheel drive. The higher limits can be used to better advantage with the front wheel drive. Now the matter of the lower limit. If too low a limit is established, in

other words from 2 pounds on down, then the gripping factor of the track becomes less and less, and a point is reached where hauling or using a machine as a prime mover becomes impossible.

5. Cargo Handling Machinery.

There has been found a need from time to time for methods of handling cargo in the snow other than by manpower, and it has been discovered that the fingerlift is a very handy item provided it is not too big and heavy. In other words, we go right back to having a big heavy machine which might get stuck versus a lighter one. The tracks will have to be made sufficiently wide on a machine of this type so that when the load is put on the front end it will not bury itself. A small beam type crane is another item that can be used to great advantage, but it, too, must not be made too large in order to handle it easily on a snow surface. There are limits on all of these things due to the type of surface on which one operates. Another thing which is rather important and which was mentioned previously is the size of the machines to be used. In general it is better practice to use two smaller type machines which we know will operate rather than one big one about which there might be some question as to its operating efficiency. In other words, a small machine is less liable to get itself buried in and get into difficulty when handling heavy loads. It requires very little more fuel to haul four sleds, let us say, with two lighter tractors than three sleds with one big tractor.

6. Cargo Sleds.

The 1-ton quartermaster sled is a very nice item. It is limited because it is made of wooden construction and has to be treated with considerable care. It is not what might be termed an ideal type of sled for ship unloading since in an operation of that

type, where cargo is being dropped from the ship's side by booms, etc., the wooden type sled is liable to get crushed and the mortality rate runs high. For shipside unloading a very simple type of sled is needed—nothing big and heavy. A type of scoop or something on the order of a farmer's stoneboat is nearer the ideal; it is low down so that men can work around it and lift cargo off and on without having to lift everything up 2 or 3 feet to get it onto the sled. This can be made with an upturned steel plate in the front, with about half a dozen 3- by 12-inch or 3- by 8-inch planks bolted to them, internally braced with a cross bolt running through the full width, possibly with a couple of skids on the bottom to keep it from going sideways. A terrific amount of cargo can be handled on a sled of that type. There is no point in hauling 3½ tons of sled with 5 tons of cargo on it, when it could be done by putting 7 tons of cargo on a sled which weighs 1½ tons.

7. Light, General Purpose Vehicles.

In the matter of vehicles which are nearer the ideal for over-the-snow transportation, we come to the cargo-carrier M29C, or "Weasel". This machine is probably the nearest approach to an ideal machine for over-the-snow travel for general purpose, reconnaissance, and errand-running. It takes the place of the "Peep", or "Jeep", as some people call it. However, there are several things that are wrong with this machine that need to be rectified to make it one that could be trusted for a longer journey and one which would have a lower mortality rate. In the first place, it is a rear wheel drive machine. Consequently, as it runs along, a torque component is built up which forces the front end of the machine up in the air and after it reaches its climax it falls and its nose drops down and then immediately rises up again, so that it has about the same action as a bucking bronco. Every time it pitches

like this it throws a terrific strain on the transmission. The transmission of the machine appears not to be too heavily constructed, and it is only a short time before teeth of the gears begin missing and all sorts of things happen to the inside of the transmission. They go bad in general. Another thing which seems to be weak on this vehicle is the tracks, plates, etc. They are held together by a steel band and rubber band combination which does not appear to be too satisfactory a method of bonding the individual plates together, particularly in colder temperatures, since this combination of rubber and steel becomes very stiff and fractures are very likely to occur. Sometimes it is necessary in starting these machines in cold temperatures to rock them back and forth for several minutes to get the initial bend out of the tracks so that they will fall around the idlers and get going.

8. Fuel.

The matter of operation of motorized equipment for polar transportation is very little different from operation in any other part of the world. There are a few precautions which must be taken, however. One of the most important is in the matter of fuel. All fuel should be filtered very, very carefully and if possible run through a chamois skin or

filter of that type to strain out all the moisture, particularly any snow which might have gotten into the drum while it was open. Another extremely important thing in cold weather is attempting, as far as possible, to keep the fuel tanks full or nearly full at all times. Fuel tanks have a tendency to sweat when only partially full, and a rind frost forms on the inside of the tank. As the vehicle progresses the slosh within the tank washes this rind down and in a short time it gets into the fuel. It is liable to lodge at the first elbow or bend in the fuel line, and in a short time the fuel line will be stopped up.

9. Ignition Systems.

The ignition system on gasoline operated vehicles is also very important, particularly to make starting easier. A great deal of attention should be paid to the clearances of spark plugs, ignition points, or distributor points, and the ignition system in general. Batteries have a tendency to run down very quickly. In colder weather the life of a battery is in general not quite as long as it is under normal operating conditions in temperate climates. Operation as a whole, however, is very little different from anywhere else except for the personal discomfort involved.

AIRCRAFT OPERATIONS

SECTION I. R4D (C-47) Operations in the Antarctic

1. Airplanes Employed.

The aircraft used by the Central Group on this expedition consisted of six C-47 type aircraft (designated R4D's by the Navy), one Norseman C-64 (Navy designation JA), and two L-5G aircraft (designated OY-1 by the Navy). Helicopters were used by the ice breakers for reconnaissance. PBM type aircraft were used by the Eastern and Western Groups. Helicopters were also used by the Eastern and Western Groups. In addition to these aircraft the Coast Guard had at least two small biplanes (Navy J2F) which are standard equipment aboard their ice breakers. The remainder of the discussion is concerned primarily with the six C-47's or R4D's which flew from the U. S. S. *Philippine Sea* to Little America and then continued their operations from Little America.

2. Special Equipment.

The R4D's were standard C-47 type aircraft as used by the Navy with certain exceptions in the way of special equipment. First, the aircraft were rigged for JATO. Second, they had a combination ski-wheel landing gear. This will be described later. Third, they were equipped with tri-nitrogen cameras. In connection with this they had "gremlin" recorders, which were simply an 05-A type camera photographing an altimeter and a clock at regular intervals. Each aircraft carried two fuselage gasoline tanks. Each of the tanks was of 402-gallon capacity, identical to those already mounted

within the wings. The total gasoline capacity of the aircraft was thus 1,608 gallons. Special equipment installed in the aircraft for this particular mission consisted of the following items: Two "bird-dogs," which are a pair of radio directional finder equipments, connected through a single indicating panel with two needles, one red—one green, indicating each separate radio; an APS-4 radar set, SCR-718 radar altimeter, APM-1 radio altimeter, and 05-A radar recording camera which was jury mounted for the APS-4 radar.

3. Flight Personnel.

The standard crew that was used with these aircraft consisted of three rated naval pilots, one being the first pilot and commander, one being the co-pilot, and the third one the navigator. These men were all NATS (Naval Air Transport Service) pilots and had had considerable experience. In addition to these a radio operator and a photographer were carried. The three pilots of each aircraft all had obtained considerable flying experience with NATS upon runs where the radio aids were good. The result was that the navigation was not as good as it should have been for this type of a mission. Navigational training was given to these men on the way down aboard the *Philippine Sea* but they still were not thoroughly familiar with the grid system of navigation which is a prime requisite for any exploratory flying either in the Arctic or the Antarctic regions.

4. Landing Gear.

a. The landing gear set-up on the C-47's consisted of standard wheels as used on all C-47's with the addition of large skis. This large metal ski was mounted so that it straddled the wheel, the cut out portion of the ski surrounding the wheel (fig. 140). Immediately in front of the wheel hole in the ski was an additional cut so that when the ski retracted with the wheel the oil cooler of the engine could protrude through the ski. When in the retracted position the toe of the ski curved up around the cowlings of the nacelle behind the propeller. The ski was fastened to the axle of the wheel and was retracted or lowered as the wheels were pulled up or let down. When in the fully down position one bungee shock cord and restraining cables were properly rigged, but during the time that the wheels and skis were coming up or going down these devices



Figure 140. C-47 ski-wheel combination. Note cut out portion of ski surrounding wheel



Figure 141. Tail ski-wheel combination. Note tail wheel protruding through ski.

would be loose so that the ski would be free to tilt unless an additional restraining mechanism was used. This restraining mechanism was built in the form of an airfoil. This airfoil was mounted upon the tail of the ski on an extension arm and served as a stabilizing influence to keep the ski in a level attitude during retracting or lowering. The ski was adjustable in relation to the wheel so that from 2 to 6 inches of wheel could be made to protrude through the bottom of the ski. The tail ski was mounted similarly with the small tail wheel protruding through the ski (fig. 141). It had no stabilizing fin, however, as the tail wheel is nonretractable.

b. There was much discussion aboard the *Philippine Sea* as to how much the wheels should protrude through the skis for the carrier take-off. One stand on this was that 2 inches of protrusion would allow plenty of clearance for the skis, and even if the skis did touch the deck no damage would result, either to the deck or to the skis, as the deck is smooth and there would be very light loading on the skis. The other line of reasoning was that 4 to 6 inches of clearance should be allowed so the ski could not possibly touch the deck. The disadvantage of much wheel protruding would be felt more upon landing,

especially if a light crusted snow were encountered at the base. In this case the wheel would break through the crust, continually chopping holes, making the landing very rough, and increasing the drag of the wheel considerably. This also was not thought to be a serious point in actuality, as the drag on the wheel could not become excessive enough to cause the airplane to nose over. After considerable discussion the Commanding Officer of the *Philippine Sea* finally agreed that the amount of protrusion would be left to the individual pilot. This was done and they all chose approximately 2 inches of protrusion, being more concerned about the landing than they were about the take-off.

5. Preparation for Take-Off.

Because of the wing span of the airplanes the take-off could not be made using the full deck of the *Philippine Sea*. The wing tips would not pass the island of the ship without making the airplane run excessively close to the far (port) side of the deck. The take-off run was therefore started from the central elevator, or that portion of the flight deck which is the widest on the carrier. A bright orange line was painted at a slight diagonal from the middle of the elevator to the center of the forward end of the flight deck. This gave the pilots a guide which they could follow while traveling at a slight diagonal across the flight deck. The total take-off runway was approximately 400 feet. Two schools of thought existed on the use of the JATO. The first held that the engine should be revved up and at the time the wheel brakes were released the JATO should be ignited. This would get the plane off the deck of the carrier as soon as possible. The second insisted that the airplane should start its roll, possibly going halfway down the deck before the JATO was ignited. The first would give rapid take-off ability at the expense of using the JATO power almost

completely before any airborne flight was obtained. The second system gave very good safety protection in case of an engine failure during the final part of the run or immediately after take-off before the airplane would attain enough altitude and speed to have good single engine control for ditching. The airplanes could not return to the carrier once they took off. It should be added that the take-off characteristics of the aircraft, with the carrier causing at least 35 knots of relative wind across the deck, would ordinarily be considered a safe procedure even without the assistance of JATO. The JATO was used as an added safety precaution in case of engine difficulties. This means that the second school was probably the safer in that during the first part of the run if the engines were not right there was still room to stop. With the first method, there would be no possibility of stopping in the event of trouble during the run with JATO in operation.

6. Flight to Little America.

The flight from the U. S. S. *Philippine Sea* was made safely by all aircraft. A 40- to 43-knot relative wind was prevailing across the deck at the time of take-off. The first five aircraft all used the technique of letting the run start and then kicking off the JATO. All the take-offs were very nicely made and no concern was felt after the first one had taken off, showing that the procedure worked out as planned. The last aircraft, however, used the method of igniting the JATO before releasing the brakes and some concern was caused since the pilot forgot to release the brakes until considerable time after the JATO had been ignited. His take-off, however, was made with no further difficulties and he was away adequately. The position of the U. S. S. *Philippine Sea* in relation to Little America was such that approximately a 4-hour flight was required. The first two

aircraft took off from the *Philippine Sea* and climbed to approximately 2,000 feet. They flew as a pair, holding from the *Philippine Sea* direct on the radio transmission from the U. S. S. *Mount Olympus*, which at that time was tied up in the Bay of Whales. The ice breaker U. S. C. G. C. *Northwind* was stationed about a third of the way between the U. S. S. *Philippine Sea* and the Bay of Whales and thus gave an intermediate radio direction. After numbers 1 and 2 aircraft had landed at Little America, numbers 3 and 4 took off. A relatively short time thereafter numbers 5 and 6 took off. The flights of numbers 3 and 4 were as expected and went direct in to Little America. Numbers 5 and 6 encountered bad weather shortly before rendezvousing with the *Northwind*. Just after passing over the U. S. C. G. C. *Northwind*, number 6 airplane began experiencing radio trouble and very soon became lost. Number 5 aircraft reported losing number 6 almost immediately upon entering the overcast. Number 5 continued on until it found an open place and circled there for 20 minutes trying to get radio contact with number 6. During the trip from the *Philippine Sea* to the U. S. C. G. C. *Northwind* number 6 aircraft had not made a gyro precession check nor had it made a compass direction deviation chart. Either one of these would have allowed it to continue on with its heading toward the Bay of

Whales so that it would have had no difficulty picking up the ice barrier upon arrival there. Number 6 did, however, continue on in a guess direction, eventually found the barrier, and flew down the barrier until it came to Little America. The ski landings at Little America were fairly typical of any well made ski landing of an aircraft with the exception of number 5 airplane. The pilot did not realize that stopping at the end of the landing run would permanently stall the aircraft. An aircraft must keep taxiing to keep from freezing its skis to the surface. Number 5 stopped before turning around and became frozen to the surface.

Note. The actual flight plans, the areas covered, and the photographs taken will be thoroughly covered by the Navy report of this mission. The operation of the *Norseman* was rather limited, being primarily a rescue vehicle. It was, used however, to give Navy pilots their required flying time. The airplane was damaged on several occasions so that it could not be used for the majority of the time that it was in the Antarctic. The helicopter operations in the Antarctic were quite impressive, giving a very fine demonstration of their ability to operate from small ships over ice pack for exploration or rescue purposes. The two helicopters that were lost were both lost through pilot error and not through anything that is unique to the Antarctic in itself. The operation of the L-5 and the place for small aircraft in Antarctic exploration and in scientific support of an expedition are covered elsewhere. The use of a towed aircraft for long range exploration and for rescue is likewise covered separately.

SECTION II. Technical Observations

1. Aircraft Loading.

At maximum total aircraft loading (about 32,000 lbs.) the loading on the skis came to about 750 pounds per square foot. Ordinarily 250 pounds per square foot is considered about the right amount of loading on aircraft skis. The excessively high 750

pounds per square foot loading on this particular design caused some concern. Therefore, on the trip down aboard the U. S. S. *Philippine Sea*, it had been planned that the wheels would be removed from the middle of the ski and an additional plate would be added in this area. The slot in the

forward part of the ski had to be retained because of the oil cooler as noted above, so a plate was made that would cover up just the wheel hole itself. This plate had a turned up forward edge or toe just as on a normal ski. The addition of this plate would theoretically lower the loading to approximately 450 pounds per square foot if the distribution of loading on the ski remained the same. There was much discussion as to whether the balance of the ski would be changed, that is, whether the loading would be unevenly distributed so the resultant 450 pounds per square foot loading was really not a true value. The wheels were removed from the aircraft and the additional area plate inserted. The plate became a detriment rather than an aid, as the snow which accumulated in the front of the turned up part or the toe of this additional plate could not pass around to the side, and therefore just accumulated until the ski was pushing a pile of snow ahead of it. These plates were subsequently removed and the remainder of the R4D flights made with neither the plate nor the wheels—using only the original ski.

2. Use of JATO.

The first take-offs from Little America were made with the JATO, but as the surface became hardened with the colder weather the use of JATO was of no material advantage and it was abandoned.

3. Stabilizer Arms.

The stabilizer arms of the skis began breaking loose from their mountings after a fair amount of flying had been accomplished. The arm would break loose from the mounting on the inside, and then the other side would come loose. Two reasons were suggested for this failure. First, that vibration of the engines while airborne induced a continuous vibration in the arms which eventually cracked the structure. Second, that the very high

loading resulting from landings and take-offs on the rough surface pounded the arms until cracks started. The first developed as a result of the breakage of the first arm during an approach for landing at a high r. p. m. operation of the engine. The second was advanced because visual observation showed a great deal of hammering of the skis during landing.

4. Skis.

After cessation of operations at Little America it was noticed that some of the main skis were beginning to crack at the toe turn-up stiffening section. This was the result of the many landings on the ice shelf which were very rough and involved tremendous pounding.

5. Parking Aircraft.

To prevent the difficulties experienced in getting the heavy aircraft moving they were parked on oiled plywood anchored to the snow. This meant that an airplane would land and taxi to the plywood platforms, where it would stop. It could then be started under its own engine power with a slight amount of movement (of the tail, etc.), whereas if it were stopped on the snow surface, a great deal of difficulty was had in making the airplane move. It was also found advisable to drag a runway take-off area. This is more fully covered in the engineering report.

6. Warming Engines.

Cold weather air operations during the summer in the Antarctic are not materially different from cold weather operations in any part of the northern hemisphere where the temperatures range down to minus 20 or 30° Fahrenheit. Herman-Nelson heaters, one for each nacelle, were used for starting (fig. 142). Inadequate covers were supplied. Some of these were fabricated aboard the



Figure 142. Herman-Nelson heaters are standard equipment.

U. S. S. *Philippine Sea* on the way down. Ample covering would have materially aided in the starting of the engines. On a very cold day inadequate heating of the nacelle resulted in rupture of the lubricating oil lines upon starting. The standard heaters, properly maintained and properly used, make a very good method of warming the engines for starting.

7. Navigation.

The original navigational plan had depended upon having the U. S. S. *Mount Olympus* with its high powered transmitter as a homing aid. The original plan of the air operation assumed that flights would not be made beyond the range at which they could home on the *Mount Olympus*. This range actually was less than the range of the aircraft that had been used on previous expeditions to Antarctica. The U. S. S. *Mount Olympus* had to leave the bay, however, because of the bad ice conditions and was not available for this purpose. The navigation then reverted to a sort of pilotage using mountains and the known landmarks primarily. A few of the pilots actually did use a good system of navigation, but the navigation

was not as good as it had been hoped that it would be. The result was that no systematic set of gyro logs were made and no good navigational tries were had. There were only a few flights that attempted to go over the top of any bad weather to get on the other side of it. This was primarily because the navigation was not reliable enough to allow that to be done. The original plan had called for both GCA and GPN and UPN-4's (portable radar navigation beacon) to be operated at the base. The GCA had to be removed to be evacuated on the *Mount Olympus* before it had a chance to be used. The GPN was retained and did help very materially in getting the aircraft in during periods of low visibility or near-blizzard conditions. The UPN-4's had been planned as beacons for marking the ends of the landing strips. They were not used for this because maintenance on the radar was not adequate.

8. Icing.

It had previously been claimed that no icing would be met. This came from the situation on previous expeditions where no flying was attempted unless CAVU conditions existed. With the advent of larger aircraft, flights were attempted with less insistence on perfect weather, and when conditions were not CAVU icing was encountered. This corresponds to experience in the northern parts of the world.

9. Emergency Equipment.

The emergency equipment which was pre-planned in the United States and that which was carried aboard the U. S. S. *Philippine Sea* was not acceptable by the command upon the ice. Thus, Dr. Siple and Captain Horney, U. S. N., had to replan and reassemble all the survival equipment and emergency rations. These are covered in chapters 6 and 7. The difference between the Arctic and the Antarctic or the North

Pole area and the South Pole area is very marked. The safety problems in the Antarctic are much different and in many respects more simple than those of the Arctic Ocean. Airplanes in distress can almost always find a place to crash land in the Antarctic, a place where the plane can be set down with relative safety. This is especially true if the navigation is good. The reasons for bailing out are much less valid than they would be in the north. The possibility of getting an airplane down with the structure mostly intact is very good. This also changes the aspect of the emergency equipment to be carried.

10. Radius of Operations.

In considering the range problem it must be realized that a 500-mile radius about Little America had already been well covered and that 800-mile flights had already been made into several areas. That meant that with a 1,900-mile total range, and an 800-mile radius of action with reserve, there was not a great deal of new territory that could be covered. It turned out that the amount of flying accomplished just about covered the territory that could be covered within 800 miles. Had a normal year been met, however, it would have been advantageous to establish one or two staging bases which would have tremendously increased the

area accessible to exploration. Especially would this create an opportunity to explore that area between the Ross Sea and the Weddell Sea, one of the big remaining question marks in the Antarctic. It would also allow one or two trips to be made on to the polar plateau or perhaps a more thorough investigation of the mountains running from the plateau toward the east. A trip or trips across the continent could have been accomplished in this manner. The problems concerning staging are, of course, considerable. It is pointed out, however, that those bases could have been established and transcontinental flights could have been made. In this regard it was considered that flights could be made with two aircraft going out, landing, transferring all the fuel to one aircraft, and abandoning the other aircraft. Or, the refueling aircraft could have been flown home. A staging plan with radii up to 1,700 miles was considered, with 1,700 miles still leaving a safety margin with a single staging point. Another problem which must be considered in this are the cold starting if aircraft are to be on the surface longer than the necessary refueling period. Two additional problems must be considered when it is extremely cold: The rescue problem would become more difficult and the navigation problem would also increase.

SECTION III. Recommendations

1. Recording Observations.

It is recommended that for any future operation of this nature the planning and training be such that complete systematic recordings of the following instruments and procedures be made:

a. The electric gyro and the vacuum gyro should have complete logs kept on every

flight. This will materially aid the navigation.

b. The compass reading vs the grid heading should be systematically kept. This permits better navigation and also helps greatly to facilitate magnetic studies.

c. The complete navigational log with all corrections should be kept as the flight is

made. This allows reconstitution of the flight after the return to the base and thus helps with the placing of any observations and of the placing of geographic features. Only in this manner can good reconnaissance photography be accomplished unless complete ground controls are used.

d. A complete photo log should also be maintained. This also allows interpretation, placing, and mapping of the picture. Systematic 05-A recordings should be made of the radar and of the radio and radar altimeters. These should be synchronized and perhaps synchronized with the visual camera so that complete understanding of all returns and of all the visual photographs can be attained after the mission is accomplished. It is therefore recommended that careful preselection of crews be made before starting on a trip of this kind—to get men thoroughly competent to accomplish their job, to get men who are eager and who understand why flights should be made and why missions should be accomplished, men with a will to accomplish, not just men completing an assigned flight. It is suggested that a system of briefing should be instituted so that each man before each mission is given a detailed outline upon which are his designated duties, a detailed instruction of when camera should be turned on or when observation should be made, the amount of film to be exposed, the type of things to look for, and other data of this nature. By having each man responsible for certain assigned duties the loss of scientific information will be held to a minimum.

2. Starting Engines.

It is suggested that the following system of cold weather engine starting would materially aid cold weather operations: the nacelle should be insulated internally and the air duct should be supplied with built-in covers so that when an engine is warm the air duct

covers can be closed and the engine will stay warm without a lot of air circulating through it. This will also facilitate the original heating of the engine when it is cold. A small, portable gasoline driven cranking heater unit could be designed for heating and starting engines. A small engine could be cooled with the oil from the large aircraft engine, thus heating the aircraft engine oil. The exhaust from the cranking unit can be used to heat the nacelle. A properly designed unit of this type would be a man-carried unit which a man would carry out to the wing and set in position with the spline of the cranking engine engaging the cranking shaft on the main engine, the positioning pins holding the cranking engine in position. The small engine would then be cranked and allowed to run for a short period, heating itself and heating part of the oil on the big engine. The aircraft engine would then be very slowly turned over by engaging a clutch between the little engine and the spline. While the big engine is allowed to warm up from heat of the little engine, it will turn faster and faster until eventually it is warm and ready to start. After the aircraft engine starts the cranking engine is moved to the next engine. The first engine started is thoroughly warmed up and then shut down while the second engine is started and warmed up, the insulated nacelle maintaining the heat in the first engine so that it will start with its regular electrical starter or with a very short push of the starting engine.

3. Landing Gear.

It is recommended that a thorough study of tracked type landing gear be instituted. When considering Antarctic or névé or sstrugi surface operations, wheels are at a big disadvantage in that any single small hole will stop the wheel and cause serious inconvenience or damage to the aircraft. Wheels also require well prepared, large runways.

Wheels are not versatile; they can land only on prepared areas and these landings cannot be made away from base. Nor are skis as versatile as required for good operations in the Antarctic regions. When the toe of a ski strikes a ridge the whole ski must rise, thus raising the aircraft. This makes the ski a rough mechanism on rough terrain such as sastrugi. In addition to that, skis have a tendency to stick. Their use is lim-

ited primarily to the type of surface for which they are designed. Tracks, on the other hand, could be used to fly from aircraft decks, could be used to fly from ordinary runways, and could land in snow or the névé as the case dictated. Being a flexible sort of structure any single bump is more or less absorbed by the track rather than transmitted to aircraft and this is a considerable advantage when operating on sastrugi.

SECTION IV. Log of L-5 in the Antarctic

The following log covers the flying of the aircraft No. 120462, an L-5G (Army designation) or OY-1 (Navy designation). The aircraft was a Navy furnished item for this expedition. The primary base for operations was the Navy Camp at Little America, known as Little America No. 4. The pilot on each of the flights was R. N. Davis. The flight log gives the history of each flight made from the Little America base at which the L-5 was assembled, after having been dismantled and crated aboard the *Philippine Sea*, brought to the barrier aboard the U. S. Coast Guard Cutter *Northwind*, and transported to the base camp on a Weasel-drawn sled. After assembly the L-5 was thoroughly checked, properly lubricated, and skis were fitted. The skis were of dural, manufactured by the Federal Ski Company. It should be noted that two sizes of skis are recommended by the Federal Ski Company for the L-5. The first recommendation is their smallest ski which is used on all small aircraft. The particular set here used was the next larger size and it proved to be a wise decision. The slight amount of additional weight is small in comparison to the advantages to be gained from having a longer, more substantial ski of greater bearing area. The log will explain why a steerable tail wheel is a very

valuable adjunct to a light aircraft operating in the Antarctic. In all other respects the L-5, No. 120462 was a standard L-5G with no modification. The log now follows:

*10 Feb No passengers. Landings: None.
 Time in flight: None.*

The purpose of the test was to determine the functioning of the skis upon the surface of the snow then existing and to explore the abilities of the aircraft to taxi and to turn, also to get a check on the engine performance under taxiing conditions to indicate the cooling of the engine in this climate. The aircraft was taxied at various speeds across the different surfaces to be found close to camp. No difficulty was experienced with turning either right or left, upwind, downwind, or acrosswind. The ease with which the airplane turned is attributable primarily to the steerable tail ski which is a great asset on a small plane, especially where it is required to do precise maneuvering to miss some holes blown in the surface of the snow and other obstacles which result from the maze of equipment deposited during blizzards.

11 Feb No passengers. No landings. No time.

The object of this operation was again to test the ability of the airplane to taxi,

especially at speeds approaching take-off and in crosswinds. These tests indicated that the aircraft was thoroughly ready for flight. During these tests no difficulty was found in starting the engine or in controlling the engine, everything being in good working order. During the tests on the first two days, the engine was very easily started by the application of heat from a Herman-Nelson engine heater until the oil temperature registered in the normal operating range of approximately 50° C. The heater brought the engine to this temperature in approximately 10 to 15 minutes, depending upon the wind conditions more than upon the air temperature.

12 Feb No passengers. 1 landing. 0.25 hours.

The purpose of this flight was to test fly the aircraft and to ascertain, in flight, the characteristics of the control section action.

12 Feb No passengers. 3 landings. 1.50 hours.

The purpose of this flight was to test airplane during ski landings and to familiarize the pilot with the characteristics of the landing area and the aircraft in its use upon that area. The first landing was made directly into the wind, as was the second landing. The third landing was made slightly crosswind. The landing area was just a large open space away from camp with no marked runways or specially prepared landing area of any nature. The normal radio of the aircraft was properly functioning during this and the remainder of the flight tests.

13 Feb No passengers. 2 landings. 1.45 hours.

These flights were made to test the aircraft and to become familiar with emergency procedures, especially in regard to emergency landings, and to test the difference between landing with partial flaps, full flaps, and with no aileron droop and complete aileron droop. The take-offs were also made to test the difference between partial flaps and two turns of the aileron droop in comparison with no flaps and no aileron droop. The effect of

flaps and aileron droop was determined to be quite significant, reducing the take-off run very appreciably and giving a take-off speed quite low in relation to that of no flaps and no droop on the ailerons, particularly in contrast to other light airplanes. The aileron droop feature was determined to be desirable.

13 Feb No passengers. 1 landing. 1.45 hours.

This flight was made for trim test and for practice in turns close to the ground and at altitude. The airplane was found to trim very nicely and to maintain straight flight, indicating that the rigging of the wings and the tail empennage had been properly accomplished.

13 Feb No passengers. 1 landing. 1.50 hours.

This flight was made to familiarize the pilot with the area immediately surrounding the camp area to give an idea of the area to head for in case of power failure on take-off or upon landing approach to gain a comprehensive idea of that area immediately surrounding camp so that in case of bad weather the barrier could be found and followed until recognizable marks approaching the camp and the Bay of Whales could be recognized.

14 Feb Navy photographer. 1 landing. 1.45 hours.

Flight was made to allow an official Navy photographer to make a historical record of the camp and the ice structure immediately surrounding the camp.

14 Feb Lt. Roscoe. 1 landing. 1.60 hours.

U. S. M. C. Lieutenant Roscoe was official geographer for the expedition. This flight was to give him an opportunity of observing the ice structure and ice conditions surrounding the camp area within a radius of 50 miles. This flight explored the Bay of Whales, the camp, and the crack structure running from the Bay of Whales toward Roosevelt Island, giving especial attention to Roosevelt Island and to the area immediately surrounding the area known as Seal Creek.

14 Feb Stein. 1 landing. 1.70 hours.

The purpose of this flight was to take color movies of the R4D JATO take-off. A steeply banked turn was maintained beyond the end of the take-off runway. At the time the R4D started its take-off run the L-5 was dived out of its turn to come down parallel to the take-off runway. This was anticipated to bring the L-5 alongside the R4D during the time the R4D had its JATO burning. The first attempt resulted in the L-5's running away from the R4D during the R4D's take-off run. The second attempt resulted in the L-5's maintaining fairly close proximity during the take-off. The third attempt was also successful.

14 Feb Cosco. 1 landing. 0.45 hours.

Navy Captain Cosco was the senior Navy officer in charge of the scientific program. The purpose of this flight was to allow Captain Cosco to observe seal life and seal actions in the neighborhood of Seal Creek in which approximately 250 seals, adult seals, were sunning themselves. In addition the route for an expedition to Seal Canyon was shown to Captain Cosco and the particular points of danger along that route were pointed out. Also indicated was an area upon which the L-5 could be landed at Seal Canyon.

15 Feb No passengers. 1 landing. 2.10 hours.

The purpose of this flight was to examine the Little America area and to further examine the Seal Canyon area and to make reconnaissance of the ice in the intervening area. Practice approach landings and ski touchdowns were made in the area of Seal Canyon.

15 Feb Navy photographer. 1 landing. 2.60 hours.

The purpose of this flight was to allow the Navy photographer to make historical records of Little America tent camp and of the ice and activities in the area surrounding the camp. The flight continued past Seal Can-

yon toward Amundson Arm. The photographer expressed his satisfaction with the ability of the L-5 to fly either low or high and to be maneuvered into the most desirable position for the taking of air records close to the desired object.

16 Feb Siple. 1 landing. 3.50 hours.

This flight was made to enable Dr. Siple to examine the ice structure, the Bay of Whales, and the surrounding area. The flight went from the take-off area to Seal Canyon, continued up the rough ice structure to the bottom end of Roosevelt Island, flying west down one of the long ice valleys then turning and flying east up across Amundson Arm until a high cloud bank was encountered. Motion pictures were made during this flight with a Cine Kodak Special 16-mm camera. "Stills" were also made using 35-mm Kodachrome and Ansco color film. The visual observations made on this flight by Dr. Siple resulted in a very complete story of the directions of motion of the ice and of possible pivot points of the ice in its flow. Upon landing, Dr. Siple said that this flight in itself had amply repaid the effort of bringing this particular aircraft to the Antarctic. He pointed out that the ability of the airplane to be flown safely at close range to objects under study was one of the valuable assests of this particular aircraft. Dr. Siple was the senior War Department observer and consultant to Admiral Byrd on Antarctic and exploratory matters. The pilot made a rough study of cruise control and determined that 4 hours of flight was a safe duration with some reserve under the particular conditions of flight encountered on this mission.

16 Feb 1 passenger. 1 landing. 3.60 hours.

This flight was made primarily to allow the pilot to make aerial studies of the ice to determine the pattern and ascertain certain structures pointed out by Dr. Siple on the

previous flight. In addition, it was thought desirable to make a further cruise control test using conditions varying from those in the first test. On this flight it was shown that at high cruising speeds, essentially those of approximately 100 to 105 miles an hour, the gasoline consumption increased materially. This led to the conclusion that a good cruising speed with the particular engine and propeller on this aircraft and with the skis mounted would be in the order of 90 to 92 miles an hour and the fuel consumption would allow then approximately a 450-mile range. It is noted here that the Aeromatic propeller gave this airplane good take-off performance without sacrificing good climb and airborne performance. During all of the flying done no difficulty of any nature was encountered with this propeller.

17 Feb Navy photographer. 1 landing. 1.35 hours.

This flight was again made to allow an official Navy photographer to photograph camp, changes that had occurred on the ice structure surrounding it, and to photograph the work being done at Little America Three, sometimes referred to as West Base. Here again the left window was opened many times to allow better photography and it was again demonstrated that good vertical photography could be accomplished by flying the airplane in a nose high power slip, thus allowing the wing to be lowered (in this case the left wing), but also to get that wing far enough forward so that the photographer could take pictures vertically down aft of the wing. This particular tactic is especially desirable where vertical pictures down cracks are required. In this case flights were made directly over Seal Canyon taking pictures which would show both of the vertical walls and the entire bottom of the canyon. This particular technique was previously displayed during several flights and found to be entirely satisfactory. The flight speed of the aircraft could be well maintained, thus mak-

ing the maneuver an entirely safe one as long as the pilot is careful not to put the left wing into the ground or to run into an obstruction.

17 Feb No passenger. 3 landings. 4.10 hours.

This particular series of flights was made for fuel and load tests to determine how well the aircraft could fly with overload, how well it would take off, and how it would climb, especially in an overloaded condition. It was also desired to ascertain the fuel range of the aircraft where a series of landings would be made away from the base such as would be encountered in making a series of exploratory landings up or down the barrier. The overload tests were made in anticipation of the installation of an air-borne magnetometer weighing in the neighborhood of 250 pounds. These tests showed that the airplane could fly under these conditions at least 4 hours and 10 minutes and still maintain a safe fuel margin in good weather conditions. These flights were made using information gained as to cruise control conditions.

17 Feb 1 passenger. 2 landings. 2.05 hours.

The two flights were purely local in nature and were made to allow eager workers to see the results of their endeavors.

18 Feb Stein. 1 landing. 1.20 hours.

The air temperatures on the 16th of February had dropped as low as 28° below zero and some discomfort was felt, especially when the rear window was opened for photographic purposes. On this trip of the 18th the ground temperature before and during take-off ran down to about 28° below zero. No difficulty was had in ground handling of the airplane or in starting it, the starting procedure still being to warm the engine with the Herman-Nelson and then to start the engine with the regular electrical starter. It should be noted that at no time during the stay did the battery freeze or was any difficulty experienced with the electrical system. This particular flight was made for

the benefit of Navy Lt. Stein who was an official Navy photographer. The technique of a short as possible take-off was demonstrated to Lt. Stein on this day, the take-off being made into an approximately 15-knot wind directly across the main runway which was in the neighborhood of 200 feet wide. This runway had been dragged and had two ice ridges, one on either side. The take-off run was started from the ridge on the North side of the runway. The pilot warned Stein that there would be a considerable jolt as the ice ridge on the other side of the runway was struck. However, the L-5 was airborne before striking the second ridge, the skis never touching that ridge. Stein experienced quite a bit of discomfort due to the cold which went to about 30° below on this particular flight. The temperature was recorded upon the centigrade indicator built in the roof of the cabin of the aircraft. It should be noted that Stein had the rear window open the majority of the time.

18 Feb Coby. 1 landing. 1.00 hour.

Navy Chief Coby, one of the dog drivers and caretakers, desired to see the distribution of the seal, as they are starting to dive under the ice and it is becoming increasingly difficult for him to find seal meat for the dogs. Instead of the great number, approximately 400 seals, to be found in the immediate area, only twelve were spotted this late afternoon.

18 Feb Johnson. 1 landing. 1.00 hour.

Johnson is Coby's helper on the dog teams and the purpose of the flight was to allow him to map a safe route to the remaining seals and to make certain of the location so they could be easily found.

18 Feb No passengers. 3 landings. 3.20 hours.

This series of flights was made to determine the feasibility of using a weight upon the end of a trailing cord to determine the roughness of the surface and to determine if this method could be used for judging

surfaces before a landing upon those surfaces. The technique involved was to find a reasonable area, drop a marker, preferably a black soot marker at the beginning of the area that looked good, then to time the aircraft's flight at a given speed until a reasonable landing distance had been established and then to drop the second marker. This would normally be done after full reconnaissance of the area by making five or six flights and taking into regard the direction of the wind. If smoke bombs or smoke flares could be dropped, that would be an advantage. After the area had been chosen a pass would be made across that area with the weight hanging on the end of the cord. The airplane would let down in the approach attitude at slightly above landing speed, making what would ordinarily appear to be a power-on landing approach. The airplane, however, would be flared out at an appropriate height above the ground and power maintained to keep the appropriate speed across the area. The aircraft height would be lowered until the weight dragged on the surface, and by observing the action of the weight, the surface could be judged to determine its roughness. Sharp ridges or slowly rising ground would be indicated. While these tests were made without a passenger, it is recommended that this procedure be used with an observer to observe the action of the string and the weight while the pilot pays particular attention to passing directly across the area upon which he intends to land and in maintaining his height correctly as indicated to him by the observer. These tests were not conclusive but were indicative, and the pilot expressed a desire to make more tests to determine the limitations and the abilities of this system.

19 Feb Navy photographer. 1 landing. 1.00 hour.

This was again an official flight to take pictures of the camp area, the bay ice, and the ice barrier surrounding camp.

19 Feb Navy photographer. 1 landing. 1.50 hours.

The object of this flight was to make official Navy photographs of the return of the trail party which consisted of the two LVT's. The aircraft was flown out along the trail over which the LVT's would return until the LVT's were met, whereupon many circles and passes were made taking pictures of the LVT's as they progressed toward camp.

19 Feb Siple. 3 landings. 2.30 hours.

This flight was made to transport Dr. Siple to various areas for the study of the motion of the ice. The first flight was made to East Cape where the markers there installed were cleared of snow. The amount of motion between these markers and the ones on West Cape was measured and observed. It was at this point that the interesting mirage of camp appeared and motion and still pictures were made of that. From here the aircraft was flown to the markers which had been laid beyond West Base. During the flight from East Cape to West Base a ground haze developed and the landing at West Base was made by a let-down through this ground haze. The approach and landing in the haze demonstrated the great difficulty with which things can be seen obliquely through a haze of this type even when they can be relatively easily seen vertically. It was noted that no horizon could be seen during the final stages of the landing and that a pilot's ability to judge solely by visual means may be seriously impaired.

19 Feb No passengers. 1 landing. 1.25 hours.

This particular flight was made as an altitude test to test the rate of climb of the aircraft, the operations of the propeller at altitude at low temperature, and to determine the fuel consumption during a climb. It was determined that the aircraft climbed well to altitudes in excess of 10,000 feet. The fuel consumption control was lost during this test, so no conclusive data was obtained.

The action of mixture control was tested and its operation with this particular propeller and carburetor was determined to be satisfactory.

20 Feb Dustin. 6 landings. 2.10 hours.

The first two landings were made without a passenger. Take-offs and landings were made from a pierced steel plank mat laid on an unprepared snow surface, that is, an unpacked snow surface. The particular section of mat in use was approximately 30 feet wide by 400 feet long. The wheels had been replaced upon the aircraft. Following the second landing the passenger was picked up and the next landing made on wheels on the surface used by the R4D's for take-off and landings (fig. 143). The action of the wheels under these conditions and under taxiing conditions was thoroughly recorded by official Navy photographs. The action of the mat and of the airplane was thoroughly recorded by Army engineers assigned to the Army observers' group. Braking action of the wheels on the snow was demonstrated. These tests were all made to determine the feasibility of operations of larger aircraft on



Figure 143. L-5 on wheels taking off from snow runway

prepared surfaces. The action of the wheels was deemed satisfactory.

20 Feb No passenger. 3 landings. 3.50 hours.

The purpose of this series of flights was to make experimental landings away from base but within the immediate area of base. The landings were made on various kinds of surfaces to determine the limitations and abilities of the ski on this particular aircraft. One of the landings was made on a surface so hard that only the keel of the ski left a mark. This particular landing was made on an area that had sastrugi of approximately 6 to 10 inches' height. The airplane was shaken but not damaged. While the landing felt rough and the take-off was relatively rough no difficulty with control of the aircraft was experienced at any time and the action of the skis was very satisfactory. From these landings and from the previous one of the trailing weight, the pilot concluded that great numbers of areas could be safely landed upon for any needed purpose such as rescue, resupply, or exploration. In particular this test demonstrated that the concept of a towable small aircraft was a valuable concept.

20 Feb No passenger. 4 landings. 3.10 hours.

This flight was made for several purposes, one being an examination of the barrier on the ocean side, the other as a cruise control study.

21 Feb Stein. 1 landing. 3.50 hours.

This flight was made to allow an official Navy photographer, Lt. Stein, to take pictures with a large airborne camera of the ice structures, particularly those in the Amundson Arm area. The flight was successful in spite of very cold temperatures encountered. The photo coverage, being the lowest level coverage yet obtained on a single flight, covered areas not previously photographed, especially those on the eastern side of Roosevelt Island.

21 Feb No passenger. 1 landing. 0.80 hours.

This was a local flight to test a classified concept.

22 Feb 1 passenger. 1 landing. 3.10 hours.

This flight was made in search for Emperor Penguins to be returned to the United States.

The total number of landings made during this series of flights was 47. The total number of hours flown, 57.70.

It is advisable to have good shoulder straps, of the standard Army type during this type of flying. Strict attention should also be paid to loose objects in the airplane, especially when making landings and take-off's away from the base airstrip so that in case of a broken ski or perhaps falling into a crevasse or any other reason that might result in a nosed up or turned over aircraft, the minimum amount of injury would result to the pilot or passenger unless of course an object is struck while in full flight, but during landing or take-off operations the safety of the occupants of the aircraft is relatively high if these precautions are taken. For this type of operation skis should be carefully rigged in addition to the rubber bungee snubbing cord. The cable limits should be carefully inspected and adjusted. This will prevent the stubbing of the toe of the ski or the inability to make an appropriate landing. The right rigging of the skis is especially important in long range operations requiring the utmost efficiency. No concern was felt at any time about any inadequacies in the particular set of skis. Their structural strength was good, their keels were well designed and well placed, and no damage was encountered upon the skis even with some landings in very rough icy surfaces. Particular attention must be paid to any safety or survival equipment. If at any time it becomes moist it must be dried, inspected, and repacked. For instance, a parachute which was brought down by sea had become

moist and this parachute failed to open after it had become cold. All of the above-mentioned flights were made using 100-octane gasoline instead of the 70 to 80 normally recommended. No difficulty was apparent from the use of this gasoline. It should be added that no engine dilution was used at

any time and all startings were made using the electric system. During landing operations away from base a maximum of 1 hour was never exceeded without the engines being run up to maintain adequate heat in the engine for starting. On real cold days this time was reduced to one-half hour.

SECTION V. Comments on Air Operations

by U. S. N. Observer

The following is a verbatim account of an informal discussion on Antarctic air operations. Those participating in the discussion were the Army observers and Lt. Comdr. James C. McCoy, U. S. N., Base Air Operations Officer, Central Group.

Dr. Siple.

This is in reference to Antarctic Air operations. We have asked Lieutenant Commander McCoy, Base Air Operations Officer, to explain to us, in view of the fact that we did not have an air operations officer among our Army observers' group, the lessons learned and performances carried out with the aircraft, also to recommend what he would advise if the Army were to come down and attempt an operation similar to operation "Highjump," Lieutenant Commander McCoy was Senior pilot with the United States Antarctic Expedition in 1939-41 and has therefore had broad experience in Antarctic aviation.

Lt. Comdr. McCoy.

The remarks I had in mind will be for the R4D type (Army C-47) aircraft, as that was the type used for our long exploration flights. To begin with, operating aircraft in the Antarctic presents certain problems which are not normally met with in more temperate climates. Preheating strikes me as being one of the items which must be

prepared for and taken care of prior to any flight. On this particular operation the Herman-Nelson heater, with air ducts leading to the nose section and through the accessory section for a period of time, based on the outside temperature and wind conditions, would give sufficient heat for the engine to be turned over and started successfully. Very few failures were met with due to the engine's being too cold. The Herman-Nelson heater was satisfactory while used around camp; however, other facilities had to be prepared in event an aircraft was forced down and heat had to be applied to enable it to restart its engines for the return flight. That was taken care of by an engine warming tent being placed aboard the plane and various types of heating units such as the fire pot or plumber's blowtorch which was considered sufficient for such an emergency. Oil dilution was used at all times. The oil was well diluted after the engine had started to cool and the oil-dilution system was turned on anywhere from 1 to 2 minutes, which seemed to be sufficient. Speaking of instruments, there was a noticeable lag in the reading of both pressure and temperature instruments while the plane was being warmed up, where normally the oil pressure would become operating pressure within very few minutes after the engine started. In the Antarctic

we found the lag sometimes would extend to 15 minutes or more. That we feel was due to congealed oil in the lines which had to be warmed sufficiently for the oil to circulate through the various instruments at the pliable temperature and pressure. That at first would hold many pilots back where take-off or taxi could be begun before the gage was sufficiently high; however, in time the pilots became wise to that and as long as instruments would record satisfactory performance, allowance was made for that lag. The ski-wheel combination used for the C-47, made by the Federal Ski Company of Minneapolis, was made more or less as a compromise due to the fact that the plane had to take off from the deck of a carrier. These skis were approximately 12 feet long by approximately 48 inches wide, a slot in the ski being sufficient for the wheel to extend beneath the surface of the ski and also the oil cooler which is mounted on the bottom of the engine nacelle to extend through the ski when in the retracted position. This resulted in a double ski effect with the wheel extending between the two. The pressure bearing of the skis was such that in soft snow they would sink down to where operation would be questionable with a heavy load. This was counteracted by removing the wheel and placing a plate in the wheel slot for softer snow operations. It was not an entirely satisfactory arrangement because the resistance caused by such a wide area had a tendency to retard the movement over the ice surface of the ski. The plates were discarded in some cases and we resorted to just the double runner ski, which I believe is the most efficient. I would recommend that if aircraft of this type were used again that a ski be designed along the same principle, but allowance be made for greater bearing surface, increasing the length of the ski more than increasing the width. Based on the principle of a large truck, it

is more efficient with a double wheel than with one large wheel, causing more resistance. The sticking of the ski, or the plane being broken loose so it could taxi, presented quite a problem. Possibly research could be made in devising some method by which the ski could be broken loose from the surface—by a wire dragged under the surface of the ski or some means that could jar it loose. We conquered that problem to a great extent while operating from the base by having the planes taxi upon a large piece of plywood under which were some 2- by 6-inch planks. The plywood was covered with a coating of Diesel oil which made the sticking far less than on the normal ice surface. In addition to that, it is highly recommended that large wooden mauls or sledges be carried along to strike a ski and break them loose. These had been used on previous expeditions down here and I would recommend that they be carried as regular plane equipment. The mechanic or one of the members of the crew, at the last moment, can strike the skis with the maul and so break them loose. Once the ski was broken loose and the plane taxied, you had little or no trouble maintaining headway, and the take-off itself was no great problem. JATO was used and no doubt was a great help. However, take-offs could be made with loads exceeding 32,000 pounds in some cases without the aid of JATO, which presented a problem inasmuch as it was considered unsafe for use at 30° below zero, F. Our operations were never quite that low, but we were getting down to the point where its safety was questionable.

Maintenance of planes presents a problem in Arctic and Antarctic conditions, inasmuch as the work is slow and uncomfortable. The efficiency of the men is slowed down, regardless of how willing workers they may be. A certain recommendation along that line could be considered: provide an engine

work tent which could be placed over the entire engine, coming down and including the ski assembly, and hanging down over the wings. Heat applied either through a Herman-Nelson or through various types of blow-pots or stoves, would make it a much more comfortable operation. The actual mechanics of maintenance checks present no real difficulty when the men are comfortable and when sufficient tools are available. In air operations navigation presents an entirely new problem. The inverse grid Magrader chart with the inverse grid computer was used successfully. The astral or sun compass was the final means of check. The question between the astral and sun compass is still a moot question. There are several advantages to both types. The magnetic compass, although sluggish and slow to react in a great many cases, especially near the magnetic pole, is nevertheless a valuable instrument. The variations are fairly well known in this area and by applying the best known variations, a fairly good course can be set. Sun sights were relatively accurate. A line of position could be varied greatly, but as a means of check, I would say it is definitely worth considering. The communications for our particular set-up were not as efficient as we would have liked them. Whether this was due to being based on the ice itself, I am not in a position to say. Possibly if the ships had been in the immediate vicinity we would have had a greater range for our communications. CW work was fairly reliable; we could communicate by CW to a distance exceeding 600 miles. But for the homing and for voice communications the set-up at that time was not used very much, as we could not get the range desirable.

It is highly recommended for future air operations that great care and planning be given to establishing radio range of sufficient strength of 200 to 300 miles. In addition to the radio range, the YR should be of

sufficient power that the radio compass could pick up the stations 200 to 300 miles distant. The greater the range the better, and for let down a GCA or GPN, preferably GCA equipment should be installed and set up with sufficient range to allow for the phenomenal area of navigation coming back. The percent overcast days is great in the Antarctic and the GCA would be of the utmost value in bringing the pilots in. A GPN was installed at Little America and on numerous occasions proved of great value in bringing the planes in and orienting the pilots prior to sight contact of the landing area. In this connection some remarks should be recorded as well as some of the difficulties encountered in flight due to icing or mechanical difficulties and material failures. Icing was encountered when entering clouds or in icing conditions, snow crystals, moisture, etc. Even at extreme low temperatures when flying through clouds, icing would collect on the propeller. Incidentally there were few cases of wing icing except when over the water areas or when the temperature was such that moisture could form in the air. The props, however, did pick up some ice and ice formed on the inner and outer surfaces of the windshield. The inner surfaces iced up due mainly to the pilot's breath. This could be combatted if the defrosting unit had sufficient heat thrown against the surface to melt it away. In a great many cases this was not the case and we had to resort to chamois skins soaked in alcohol to wipe the ice away from the windshield. The carburetor heat was used wherever conditions indicated its necessity and no case of carburetor icing-up was recorded on this operation. We had certain instrument failures due to lines carrying away, possibly caused by particles of ice forming and rupturing the line; we had considerable trouble with the winter propellers, surging of the propellers, and in one case tendency to

flatten out the pitch of the propeller, causing delayed force action. We had various material failures with the ski, mainly the ski stabilizer. The material used on the ski stabilizer and the arms supporting it was too thin a gage of metal, and in one case we had as many as five failures after landing. I say after landing, because the stabilizers dropped off after the landing on the runway, either while completing the landing run or taxiing back. They completely broke or fell off. The failure of that type was foreseen and preventives were installed on the ski as a safety measure, which in this case proved a very wise precaution.

In connection with flying, I would like to point out the desirability of having advanced weather stations 200 or 300 miles out if possible, and if the scope of the operation would allow, have these weather stations equipped to act as rescue bases with sufficient food, clothing and a supply of fuel to enable a plane, if forced down in the vicinity, to be replenished with supplies, or at least rescue personnel. That comes under the scope of the operation plan. To make a successful weather station, communication facilities should include a portable range or facilities for the pilot's finding the station and letting down, as the overcast is such that he may fly over it many, many times without actually sighting it, and also facilities at this station for extended ground rescue operations.

Another subject which possibly should be considered in planning an operation of this type is the spare tools and equipment to be carried. I will not go into detail about the spares or the equipment, but I would like to point out that such articles as starters, carburetors, generators, etc., do fail when operating under conditions such as this. The accessories should be readily assembled to replace an entire unit rather than to try to make field repairs. As an example, starters are under great strain when turning over an

engine that is stiff. These spares should, of course, be kept in a cache near a shop ready for use when the occasion demands or available to send out to a plane if forced down, using aircraft or tractors and sleds if they are sufficient to haul out the necessary equipment. A word in marking supplies should be placed here. When unloading from a ship, the method of checking material, keeping track of it, protecting it from the elements, and placing it in position where it can readily be found, even though a blizzard should cause enough snowdrift to cover it over, are all questions which must be considered and prepared for. Tools, for instance, are very easily lost; a tool laid carelessly alongside a plane where work is being carried on could easily be covered over with snow in a very short time if drift conditions occur, and once it is lost it is lost forever. The percent of tools and equipment lost under any condition in the Antarctic is extremely high.

As executive officer of the base, one of the big problems I had to contend with was mustering the men and keeping track of their whereabouts. Mustering the men presented quite a difficulty. We had very poor communication facilities, and for any one person to call around to each tent individually was really a morning's work. I would highly recommend that field communications be set up—telephones, walkie-talkies, or other sufficient means of communication. Transportation presented quite a problem, mainly from the aviation standpoint. Tractors and vehicles must be made available to haul supplies and equipment and to tow gasoline and oil to the aircraft. Many times, planes coming in for refueling or to be supplied would have to wait, men would have to be rounded up, tractors or vehicles made available to take care of their wants. All in all, I believe a more efficient set-up for communication and transportation could be devised.

I believe there are great possibilities for gliders in the Antarctic. I am not prepared to go into the mechanics of glider operation; however, I do feel that for supplying advanced stations or assisting men from a wrecked plane, or in bringing in supplies to a stranded party, they have great possibilities, and I am firmly convinced that the glider has a place in Antarctic or Arctic operations and explorations.

Army observer.

In regard to the plane crew, what is your feeling concerning trained observers for exploratory flying?

Lt. Comdr. McCoy.

Trained observers are necessary. If you had planes which could possibly carry a crew of six, the ideal crew would include the pilot, co-pilot, navigator, observer (trained), radio operator, and photographer. However, as we were handicapped by the limitations on the weight, we had to restrict our crew to five. Had the pilot or co-pilot, for instance, been a trained observer, a great many observations could be made and recorded in such a manner it would have been of far greater value to us than the recordings which we received, which in a great many cases were vague and unreliable.

SECTION VI. Air Operations Logs—Central, Eastern, and Western Groups

1. Air Operations Log, Central Group.

Times and dates are G. c. t.

Date (1947)	Type	Name	Flight objective	TD	TA	Remarks
23 Jan	A2	Campbell - Shirley; McCoy-McGlas- sen.	Photo famil....	230735	231135	First flight from snow field at LA.
24 Jan	A2	C a m p b e l l - McNally-Mini.	Famil.....	240015	240415	Famil.
24 Jan	A2	Quackenbush- McCoy.	Famil.....	240600	241030	Famil.
25 Jan	A2	Mini-Allison.....	Famil.....	251930	252330	Famil.
26 Jan	..	.....	.....	.....	.....	No flight—JA down for starter spring.
27 Jan	..	.....	.....	.....	.....	No operations due to weather.
28 Jan	..	.....	.....	.....	.....	Do.
29 Jan	..	.....	.....	.....	.....	Snow test hop by JA—McCoy.
30 Jan	V1	Hawkes-Byrd.....	Philippine Sea to Little America.	1013	1639	Routine.
30 Jan	V2	McIntyre.....	...do.....	1013	1639	Do.
30 Jan	V3	Linn.....	...do.....	1835	2329	Do.
30 Jan	V5	Anderson.....	...do.....	1847	2339	Do.
30 Jan	V4	.....	...do.....	1917	31/0045	Do.
30 Jan	V6	Weir.....	...do.....	1915	31/0106	Commo trouble. Cockpit fog.
31 Jan	..	.....	.....	.....	.....	No operations due to weather.
1 Feb	..	.....	.....	.....	.....	Do.
2 Feb	..	.....	.....	.....	.....	Do.
3 Feb	..	.....	.....	.....	.....	Do.
4 Feb	..	.....	.....	.....	.....	Do.

Date (1947)	Type	Name	Flight objective	TD	TA	Remarks
5 Feb	A2	Tanner-Allison....	Photo famil....	050230	050630	Shot of Bay of Whales, etc.
5 Feb	V1	McCoy-Hawkes...	Para jump....	.....	.....	Jump by 1st Sgt. London.
5 Feb	V1	Various hops by crews.	Checking out.			
6 Feb	V1	.....	Check out and famil. hops.			
6 Feb	V2	.....	Check out and famil. hops. Para jump.	.....	.....	Jump by C. B. M. Johnson.
6 Feb	V3	.....	Check out and famil. hops.			
7 Feb	..	.....	.....	.....	.....	No hops—preparing all planes for flight.
8 Feb	..	.....	.....	.....	.....	No operations—all planes ready for take-off. Test take-off JATO— 1,200 gal.
9 Feb	..	.....	.....	.....	.....	No operations.
10 Feb	V1	.....	Photo.....	100050	100455	First operational flight out.
10 Feb	V2	.....	Photo.....	100050	100510	Photo.
11 Feb	V3	.....	Photo.....	102150	110300	Photo.
11 Feb	V5	.....	Photo.....	102150	110300	Photo.
12 Feb	..	.....	.....	.....	.....	No operations due to weather.
13 Feb	..	.....	.....	.....	.....	Do.
14 Feb	V1	.....	.....	141205	142115	
14 Feb	V2	.....	.....	141205	141945	
14 Feb	V3	.....	.....	142253	150710	
14 Feb	V6	.....	.....	142253	150824	
15 Feb	V1	.....	.....	150315	151321	
15 Feb	V2	.....	.....	150315	151321	
15 Feb	V3	.....	.....	151340	152253	
15 Feb	V5	.....	.....	151340	152253	
16 Feb	V1	.....	.....	161005	162245	So. Pole.
16 Feb	V6	.....	.....	161005	162245	Do.
17 Feb	V3	.....	.....	172150	180801	Ret. due weather.
17 Feb	V6	.....	.....	172156	180225	Ret., eng. trouble.
17 Feb	V2	.....	.....	172221	180840	Photo Mt. Erebus.
18 Feb	V1	.....	.....	180014	180620	Ret., eng. trouble.
18 Feb	V5	.....	Photo.....	180850	181243	Photo Discovery Inlet.
19 Feb	..	.....	.....	.....	.....	No operations due to weather.
20 Feb	V3	.....	Photo.....	202236	210924	Photo.
20 Feb	V5	.....	Photo.....	202335	210924	Photo.
20 Feb	V1	.....	Made M. A. D. hop in area of Rockefeller Mountains.			
22 Feb	V2	.....	.....	221600	221930	Ret. due weather.
22 Feb	V3	.....	.....	221600	221930	Ret. due weather.

2. Air Operations Log, Eastern Group.

Times and dates are G. c. t.

Date (1946)	Type	Name	Flight objective	TD	TA	Remarks
25 Dec	H0	Sessams.....	Recon.....	.....	.....	Ice recon (Pine Is.) 252102, 68.3, 252116.
26 Dec	..	.....	.....	.....	.....	No flights due weather.
27 Dec	..	.....	.....	.....	.....	Do.
28 Dec	..	.....	.....	.....	.....	Do.
29 Dec	G1	NR1.....	Recon photo...	292135	300555	CTG 68.3 Observer.

Date (1946)	Type	Name	Flight objective	TD	TA	Remarks
30 Dec	G2	NR2.....	Recon photo...	300136	301231	CO P. I. Observer. Overdue since 1948.
30 Dec	G1	NR3.....	....do.....	300048	.....
31 Dec	..	.....	.....	.....	.....	Last est. posit. at 301948-71-22S, 99-30 W. No flights due wea. Overdue. Preparing for rescue flights.
(1947)						
1 Jan	..	.....	.....	.....	.....	No flights due weather. Assembling PBM-3G. Estimated time completion 051700Z.
2 Jan	..	.....	.....	.....	.....	Preparing for flight. Hoisted out G2. Boat failed alongside ship, causing plane to strike ship, damaging part wing tip, part aileron, and part deicer. Estimate in commission by 030900Z.
6 Jan	G3	NR1.....	Rescue.....	060232	060457	Returned due to weather.
6 Jan	G3	NR1.....	Rescue.....	061915	070424	68.3 on board. Negative Search and Rescue (68.3 070902) Oblique Photo.
7 Jan	G2	.....	Test.....	072238	.....	Recalled due to weather.
7 Jan	G3	.....	Test.....	072238	.....	Do.
8 Jan	G2	.....	Search.....	082045	082059	No results, fog ceiling.
9 Jan	G2	NR2.....	Search.....	091546	091711	Turned back—bad weather.
10 Jan	.....	.....	.....	.....	.....	No flights due weather.
11 Jan	H0	Ubiki.....	Ice recon.....	110025	110126	Ice recon.
11 Jan	G2	NR2.....	Search and rescue.	111241	120025	Found G1 and 6 survivors 111729 (DNR) at 71-03S, 98-47W. 3 dead. Survival gear dropped by G2. Survivors 10 miles from open water. Trail marked by G2 to open water over survivors at 120000. Landed 120207. Howell and Conger ashore in raft. Party 2 miles from beach. Fog set in at 0614Z. Thin ice necessitates shifting of plane occasionally. Fog between plane and beach. 121257 commenced picking up survivors. 121424 airborne. 121643 landed at P. I.
11 Jan	G3	NR1.....	Rescue.....	112100	120207	No flights due weather.
12 Jan	G3	NR1.....	Rescue.....	121424	121643	
13 Jan	..	.....	.....	.....	.....	Do.
14 Jan	..	.....	.....	.....	.....	Do.
15 Jan	..	.....	.....	.....	.....	Do.
16 Jan	..	.....	.....	.....	.....	Do.
17 Jan	..	.....	.....	.....	.....	Do.
18 Jan	..	.....	.....	.....	.....	Do.
19 Jan	H0	Sessums.....	Ice recon.....	192002	192057	H03S-1 Bu No 57996 settled in water on approach due icing main rotor. No injury personnel. H0 total loss. Crash boat rescued personnel within 1 minute.
20 Jan	..	.....	.....	.....	.....	No flights—due weather.
21 Jan	..	.....	.....	.....	.....	Do.
22 Jan	..	.....	.....	.....	.....	Do.
23 Jan	..	.....	.....	.....	.....	Do.
24 Jan	G3	1.....	Photo.....	240109	240842	Desp 241145 met walker circled 15000 chart V30-107 coast south.

Date (1947)	Type	Name	Flight objective	TD	TA	Remarks
24 Jan	G2	2.....	Photo.....	240142	241000	Desp 241351 sighted Mt "X" range.
25 Jan	..	.....	.....	.....	.....	No flights.
26 Jan	G2	2.....	Photo.....	261048	261823	Filling in gap between 110° W and Norville range.
26 Jan	G3	1.....	Photo.....	261200	261925	Do.
27 Jan	..	.....	.....	.....	.....	No flights—maint and weather.
28 Jan	..	.....	.....	.....	.....	No flights—weather.
29 Jan	..	.....	.....	.....	.....	Do.
30 Jan	..	.....	.....	.....	.....	Do.
31 Jan	..	.....	.....	.....	.....	Do.
1 Feb	..	.....	.....	.....	.....	Do.
2 Feb	..	.....	.....	.....	.....	Do.
3 Feb	..	.....	.....	.....	.....	Do.
4 Feb	..	.....	.....	.....	.....	Do.
5 Feb	..	.....	.....	.....	.....	Do.
6 Feb	..	.....	.....	.....	.....	Do.
7 Feb	..	.....	.....	.....	.....	Do.
8 Feb	G2	2.....	Photo.....	081410	081730	Photo hop to Charcot Is.
8 Feb	G3	.....	Photo.....	.....	.....	Turned back due to weather.
9 Feb	G2	2.....	Photo.....	091344	092120	Photo—returned due to weather.
9 Feb	G3	1.....	Photo.....	091523	092122	Do.
10 Feb	..	.....	.....	.....	.....	No flights—due weather.
11 Feb	..	.....	.....	.....	.....	Do.
12 Feb	..	.....	.....	.....	.....	Do.
13 Feb	..	.....	.....	.....	.....	Do. Moving to Marg Bay.

3. Air Operations Log, Western Group.

Times and dates are G. c. t.

Date (1946)	Type	Name	Flight objective	TD	TA	Remarks
24 Dec	..	.....	Recon.....	.....	.....	Limited recon: Test of commo, aerol- ogy, etc. Fueling drill.
25 Dec	..	.....	.....	.....	.....	No operations.
(thru)	..	.....	.....	.....	.....
31 Dec (1947)	..	.....	.....	.....	.....
1 Jan	B1	Burner.....	Photo.....	010535Z	011009	Recon of Blleny Grp. Weather prevented reaching Cont.
2 Jan	B1	Krietzer.....	Recon.....	011930Z	020130	{ Recon Oates Coast. Found moun- tains of 10,000-ft. Mountains between capes Cheetham and Williams 8,000 ft. Secured flight —both radio altimeters went out.
2 Jan	B2	Roger.....	Photo.....	011930Z	020130	
3 Jan	..	.....	.....	.....	.....	No operations—weather.
4 Jan	B1	.....	Photo.....	040225	041045	{ First mapping; anoxia causes fatigue at 13,550 feet.
4 Jan	B3	.....	Photo.....	040225	041020	
5 Jan	B3	Bunder.....	Photo.....	050410	051226	Capt Bond Observer—see CTF 68.2 051340.
6 Jan	B1	Krietzer.....	Photo.....	060250	061010Z	Capt Clark Observer.
7 Jan	..	.....	.....	.....	.....	Attempted flight. Operations to scout pack ahead of 68.1. No results due weather. Hoisted out 3 times.
9 Jan	..	.....	.....	.....	.....	No flights—weather.
10 Jan	B3	Rogers.....	Ice recon.....	101810	.....	{ Ret due weather. No practical recon made.
10 Jan	B1	Bunger.....	Ice recon.....	101840	.....
11 Jan	..	.....	.....	.....	.....	No flights.
12 Jan	B1	Krietzer.....	Ice recon.....	120009	120630	Eastern search to 74°S.

Date (1947)	Type	Name	Flight objective	TD	TA	Remarks
12 Jan	B3	Rogers.....	Ice recon.....	120039	120200	Western search to 74°S.
13 Jan	..	.....	.....	.....	.....	No flights—due weather.
14 Jan	..	.....	.....	.....	.....	No flights—due weather.
15 Jan	..	.....	.....	.....	.....	Do.
16 Jan	..	.....	.....	.....	.....	Do.
17 Jan	..	.....	.....	.....	.....	Do.
18 Jan	..	.....	.....	.....	.....	Do.
19 Jan	..	.....	.....	.....	.....	Do.
20 Jan	..	.....	.....	.....	.....	Hoisted out. No operations due wea.
21 Jan	B1	Bunger.....	Photo.....	212012	230138	Mapped coast 136° to 129–30.
21 Jan	B3	Rogers.....	Photo.....	211910	230317	Rugged nav. Burst rotor on H03S during strong wind.
22 Jan	..	.....	.....	.....	.....	No flights—weather.
23 Jan	..	.....	.....	.....	.....	Do.
24 Jan	..	.....	.....	.....	.....	Do.
25 Jan	..	.....	.....	.....	.....	Hoisted in—due weather.
26 Jan	B3	Krietzer.....	Photo.....	260550	261145	No report on results.
26 Jan	B3	Rogers.....	Photo.....	261900	270054	Desp 270256. Featureless plateau.
26 Jan	B1	Bunger.....	Photo.....	262026	270509	Desp 270838; object 68–18, 142–40 E. Ice cap 8,500.
27 Jan	..	.....	.....	.....	.....	Glacier valleys, etc. Fet 12.
28 Jan	B3	Rogers.....	Photo coast....	280341	281117	Coastal mapping in area 111–130 E.
28 Jan	B1	Krietzer.....	Photo coast....	280445	281130	Coastal mapping in area 111–130 E. Desp 281320. Fet 13.
29 Jan	..	.....	.....	.....	.....	No flights.
30 Jan	B3	Bunger.....	Photo.....	300330	301020	Coastal and continental recon.
31 Jan	B1	Krietzer.....	Photo.....	312007	312300	
1 Feb	..	.....	.....	.....	.....	No flights.
2 Feb	B3	Rogers.....	Photo.....	020451	021000	Turned back—weather.
3 Feb	..	.....	.....	.....	.....	No flights—weather.
4 Feb	..	.....	.....	.....	.....	Do.
5 Feb	..	.....	.....	.....	.....	Do.
6 Feb	..	.....	.....	.....	.....	Do.
7 Feb	..	.....	.....	.....	.....	Do.
8 Feb	..	.....	.....	.....	.....	Do.
9 Feb	..	.....	.....	.....	.....	Do.
10 Feb	..	.....	.....	.....	.....	One flight. See 11th.
11 Feb	B3	Rogers.....	Photo coast....	102315	110800	Coastal search 106° E. and 88° E.
11 Feb	B1	Bunger.....	....do.....	110010	110800	Cont search 97° E. and 101° to depth of 68° S.
12 Feb	..	.....	.....	.....	.....	No flights.
13 Feb	B3	Krietzer.....	Photo coast....	122320	130646	Continental photo.
13 Feb	B1	Bunger.....	....do.....	130044	131026	Do.
14 Feb	..	.....	.....	.....	.....	No flights.
(thru)						
21 Feb	..	.....	.....	.....	.....
22 Feb	B1	Krietzer.....	Map coast....	220410	221435	Princess Ragnild coast from 16° E. to 50° E.
22 Feb	B3	Rogers.....	....do.....	220625	221500	Do.
23 Feb	..	.....	.....	.....	.....	No flights.
24 Feb	..	.....	.....	.....	.....	Do.
25 Feb	..	.....	.....	.....	.....	Do.
26 Feb	B3	Rogers.....	Map coast....	260140	260945	56° E. to 70° E. coastal.
27 Feb	B1	Bunger.....	Map coast....	270841	271422	
27 Feb	B3	Krietzer.....	Photo coast....	270916	271500	69° to 71–30°.

SEARCH AND RESCUE

Since Army observers assigned to Task Force 68 included communications and transportation (Tank Corps) officers, this chapter will not go into details regarding these subjects relative to search and rescue operations. Emergency communications and utilization of ground vehicles available for rescue operations within Task Force 68 are well covered respectively by the observers mentioned above.

In setting down a rescue plan for any future Army venture to the Antarctic similar in scope and nature to Task Force 68, this chapter does not go into the technical aspects or recommendations on both subjects mentioned above. This observer feels that these topics should be covered by those who have a better technical understanding of these subjects.

SECTION I. Task Force 68 Search and Rescue Plan

The plan for search and rescue operations outlined in this section is as given in Operation Plan No. 2-46, Operation "HIGH-JUMP," U. S. Atlantic Fleet, Commander Task Force SIXTY-EIGHT.

1. Communication Plan.

a. Rescue Frequencies.

Primary Secondary Purpose

3965 kc.	4125 kc.	Rescue circuit. This frequency will be guarded by all ships, planes, Weasels, dog teams, boats, and the base when involved in rescue operations.
8280 kc.	500 kc.	Gibson Girl emergency transmissions.

b. *Rescue Communications and Aids.* (1) All plane emergency kits will be equipped with

Gibson Girl radio transmitters operating on 500 and 8280 kc. All ships and planes engaged in rescue operations during the search period will maintain a watch on these frequencies as well as on the regular rescue circuit.

(2) Plane emergency kits shall also carry a radar corner reflector so as to assist the search units in locating by radar any unit forced down.

(3) In event rescue operations become necessary, four Weasels and two dog sleds are radio equipped for communication on the rescue circuit. A number of Walkie Talkie sets are also available as may be required for short range work. All planes and ships involved in rescue operations will put a watch on the rescue circuit.

(4) Boats involved in rescue operations will carry Walkie Talkie equipment, as well as SCR-610 equipment, to enable them to communicate with planes in the immediate

vicinity on the rescue circuit. In event long range operations are required of the boats, they must be equipped with field equipment as, for instance, a TBX equipment for communication outside the range of the SCR-610.

c. Base Operations. Four Weasels will be radio equipped for construction, trail, and rescue operations.

d. Radar. Air search radars will be manned by parent vessels whenever planes are airborne. The senior ship expecting planes in

their area, even though passing by, will have air search radars manned. Radar plots of all planes will be maintained insofar as possible.

2. Rescue Plan for Eastern and Western Groups.

Rescue of personnel shall be effected by the most appropriate of the following methods:

a. In Water. (1) Employing DD using a rescue basket.

(2) Employing ships' boats.

(3) Employing SOC or PBM aircraft if water landing area is available.

b. On Sea Ice. (1) Employing ships' boats.

(2) Employing helicopter landing on ice.

(3) Landing a rescue party from boats.

c. On Continent. PBM to locate downed plane, report its position, and make supply drops as necessary. Request assistance of ski-planes of Central Group and for dog teams if within 900 miles of Little America. Using parachute drops of extra gasoline from PBM, making use of HO3S helicopter to evacuate forced-down personnel.

3. Rescue Plan for Central Group.

Rescue of personnel shall be effected by the most appropriate of the following methods:

a. In Water. (1) Employing ships' boats (fig. 144).

(2) Employing J2F from *Northwind* (fig. 145).

b. On Ross Shelf Ice. (1) Employing tractors and/or dog teams (fig. 146).

(2) Employing Norseman (JA) on skis (fig. 147).

(3) Employing helicopters and J2F (figs. 148 and 149).

c. On Antarctic Continent. (1) Employing Norseman on skis.

(2) Employing R4D on skis carrying dog teams and sled (fig. 150).

(3) Employing HO3S helicopter and fuel parachute drops from R4D.

(4) The R4D's and PBM's will be equip-

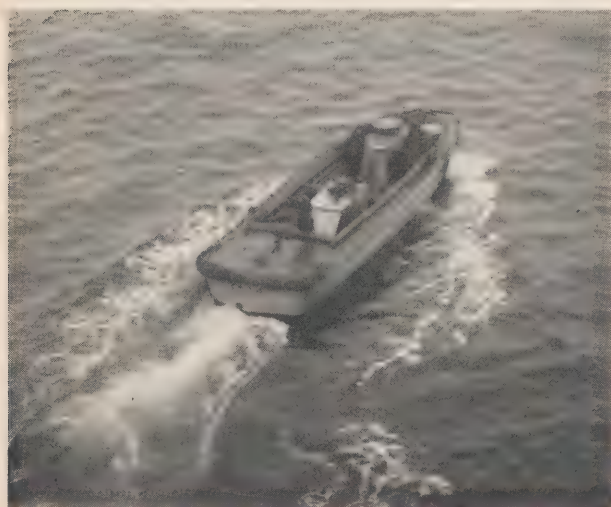


Figure 144. Personnel and cargo small boat from the U. S. S. "Mount Olympus."



Figure 145. Navy J2F type aircraft attached to U. S. C. G. "Northwind" (ice breaker).

ped with sufficient survival gear and food so that in case of a forced landing on the Antarctic Continent the crew of the plane will be self-sufficient for at least 30 days.

(5) It is planned to carry portable radio equipment on rescue boats, Weasels, and dog sleds, using 3965 kc. as primary rescue frequency and 4125 kc. as secondary communication between planes, sleds, and Weasels.

(6) In case rescue operations become necessary, the Operations Duty Officer will notify the Task Force Commander, the Chief of Staff, and the Air Operations Officer and await instructions.

4. Flight Safety Measures.

a. Flight operations shall be conducted to pursue aggressively the exploration of the Antarctic Continent with minimum risk to personnel.

b. It is planned to conduct most operational flights with not more than five or less than two planes, in which case the following safety measures will apply:

(1) Maintain half-hourly radio contact between adjacent planes.

(2) As long as contact with adjacent plane is maintained continue flight plan even



Figure 146. Dog team (nine dogs to team) showing cargo type sled with gee pole.



Figure 147. Norseman (C-64) type aircraft. This was the only aircraft specifically designated for search and rescue operations.



Figure 148. R-4 type helicopter scouting for leads in the ice pack to aid ship navigation through pack.



Figure 149. R-5 type helicopter landing on flight deck of aircraft carrier U. S. S. "Philippine Sea."



Figure 150. R4D (Army C-47) type aircraft on skis.

though communication with CTG 68.1 is lost.

(3) If plane-to-plane contact is lost both by direct communication and via relay through CTG 68.1, plane shall return to base.

(4) In the case of a single plane flight, half-hourly contact will be maintained with CTG 68.1. Should contact be lost but radio equipment be in good operating condition, flight should be continued along planned track.

(5) If it becomes necessary for any plane to deviate from flight plan because of weather

or terrain and his intentions cannot be communicated to base, plane shall return to base via reverse track.

(6) Rescue measures will be initiated by CTG 68.1 for any plane one-half hour over E. T. A., that is not in radio contact with CTG 68.1.

c. Lost planes will be guided to base by use of appropriate equipment as indicated in paragraph 5.

d. For all seaplane take-offs and landings, parent vessels will have a crash and rescue boat manned and standing by approximately

halfway down and well clear of the landing or take-off run. Crash and rescue boats shall be equipped as follows:

- (1) Medical equipment and personnel as per CTF 68 instructions.
- (2) Two life rings and lines.
- (3) Rescue kit containing metal shears, bolt cutters, and snips for quick extraction of trapped personnel.
- (4) Radio equipment tuned to rescue frequency.

5. Lost Plane and Low Visibility Procedure.

a. If a plane should become lost due to weather or other navigational difficulties, the following equipment will be available for homing by planes:

- (1) Two YR beacons at base (continuous MO's) used in conjunction with plane ADF.
- (2) Beacon at base used in conjunction with plane radar.
- (3) ZB/YG on ships in Bay of Whales.
- (4) MO transmissions by ships in Bay of Whales (414/444 Kc).

b. In case plane desires that ship take over homing the following equipment may be used as appropriate:

- (1) Plane send MO's on 414/444 Kc. (Use trailing wire antenna.)
- (2) Ship conn planes in using SK or SP radar.

c. In case the weather at base necessitates a low visibility approach, the GCA unit at the base will be given control by CTF 68 at an appropriate time and planes will be landed using standard GCA "Talk Down" procedure.

d. Voice communications will be used when possible.

6. R4D Aircraft Emergency Equipment.

a. Emergency equipment to be carried on flights when flight is to be made away from immediate vicinity of the base camp.

Item	Unit
Sleeping bags.....	1 per man.
Parachutes.....	1 per man.
Skis and ski poles.....	1 pr. per man.
Ski boots.....	1 pr. per man.
Extra socks.....	2 pr. per man.
Extra mitts and liners.....	2 pr. per man.
Mountain tents.....	1 for every two men.
Alpine or Manila rope, 8 oz. per ft. or 12 thread.	100 ft.
Sled and man harness.....	1 set.
Engine warming tent*.....	2.
Engine warming stove*.....	2.
Can, 5-gal. for oil drain*.....	16.
Funnel and hose*.....	2 sets.
Stoves, cooking.....	1 for every three men.
Mess gear.....	1 set per man.
Rations for 30 days.....	1 per man.
Trail radio or Gibson Girl.....	1.
Waterproof matches.....	1 carton.
First aid kit.....	1 kit.
Tool kit.....	1 kit.
Shovels.....	2.
Saws.....	2.
Maul (wooden, circle)*.....	1.

*In case skis are not used, these items may be omitted.

b. Survival gear to be carried in JA-1 (Norseman, C-64) at all times.

Quantity	Item	Weight
1.....	Shovel.....	4 lbs.
1.....	Saw.....	2 lbs.
4.....	5-gal. oil cans.....	8 lbs.
1.....	Funnel and hose.....	2 lbs.
1.....	Engine tent and cover....	10 lbs.
1.....	50' length Manila line...	7 lbs.
1.....	Plumbers blow pot.....	10 lbs.
1.....	2-gal. can clear gas....	14 lbs.
1 set.....	Deadmen and lines.....	5 lbs.
1.....	First aid kit.....	2 lbs.
1 set.....	Dye markers.....	3 lbs.
1.....	Cook stove.....	6 lbs.
1 box.....	Waterproof matches.....	1 lb.
1 set.....	Tools.....	20 lbs.
1.....	Mountain two-man tent..	10 lbs.
Total weight.....		104 lbs.

For each person in plane (including pilots) the following survival gear will be provided:

	Weight
(Pilot/passenger).....	200 lbs.
30-day ration.....	105 lbs.
Sleeping bag.....	5 lbs.
Skis and boots.....	15 lbs.
Additional clothing.....	5 lbs.
<hr/>	
Total weight.....	330 lbs.

	Weight
Basic weight of plane, including	
NavGear.....	5,000 lbs.
Permanent survival gear.....	104 lbs.
Two pilots and gear.....	660 lbs.
242 gal. gas and 20 gal. oil.....	1,602 lbs.
<hr/>	
Total weight.....	7,366 lbs.
Gross weight permissible.....	7,400 lbs.
Useful load remaining.....	44 lbs.

With the above loading there would be insufficient pay load left to carry one passenger with attendant gear. Pay load must be obtained at the sacrifice of range (reduction of gas load).

Rescue conditions will dictate variations in the above loading as deemed necessary by the officer conducting the mission.

c. Emergency gear for ship-based planes.

- 1 life raft.
- 1 Gibson Girl.*
- 1 emergency rations for 1 week for each passenger.
- 1 set skis and boots for each passenger.*
- 1 first aid kit.
- 1 set dye markers.
- 1 cook stove.
- 1 box waterproof matches.
- 1 set tools.
- 1 shovel.
- 1 mountain 2-man tent.

*Need not be carried in HON/H03S or HOS unless flight to extend beyond line of sight distance.

d. Radius of action for aircraft.

R4D—As ordered.

JA—300 miles.

J2F—200 miles.

HOS—Sight contact with parent vessel.

HO3S—50 miles.

Emergency flights may require an extension of above limitations if within safe fuel limitations. Helicopter must be accompanied by planes equipped for polar navigation if operated beyond above limitations.

Helicopters will not be permitted to take off if weather is below standard contact minimums (3-mi. vis., 1,000-ft. ceiling).

7. Instructions for Pilots Operating the JA-1 Aircraft (Rescue Aircraft).

Presumably the first plane to be operated extensively by the Central Group will be the NoorduyN Norseman (JA-1) on skis. It

is anticipated that familiarization flights, photo flights, reconnaissance flights, etc., will be requested soon after our arrival. After the arrival of the R4D's and the commencement of normal photo missions, *the Norseman will be primarily a rescue plane* and all other flights by the JA will, of course, be secondary in importance. Therefore, the character of flight performed by the Norseman may be broadly categorized as "routine" and "rescue" and the instructions pertaining thereto are as follows:

a. Routine Flights. (1) Plane shall not leave on any flight other than a test flight without two pilots.

(2) Test flights shall not exceed gliding distance of base landing area.

(3) All flights, other than tests, shall be cleared with both ship and base operations. Base must clear all test flights and inform ship.

(4) Senior pilot of plane shall submit detailed flight plans to both ship and base operations, including time of take-off, elapsed time, track, speed, hours of fuel, altitude, etc.

(5) Senior pilot shall insure that plane radios are operative and tuned to assigned frequencies.

(6) Survival gear indicated in the appendix hereto shall be carried as instructed therein.

b. Emergency Rescue Flights. (1) After the commencement of flight operations with the R4D's, the JA-1 may be used for routine flights only at the discretion of the officer in charge of the base camp.

(2) Inasmuch as any rescue flight will present special problems, the loading of the *Norseman* will be as determined by the officer in charge of the base camp.

(3) Pilots on all flights must constantly bear in mind the limited navigational gear available in the *Norseman* and plan their flights accordingly. There is no ADF, DF, or nonprecessing gyro in the *Norseman*: An astro compass provides the only dependable means of navigation, hence all flights will be restricted to CAVU weather.

SECTION II. Aircraft Accidents

1. Inasmuch as no aircraft accidents occurred within the phase of aircraft operations of the Central Group of Task Force 68 to which this observer was attached, it was not possible actually to witness and personally observe any search and rescue operations. However, three major aircraft accidents did occur within the Task Force. These are described in the following paragraphs.

2. While on a photo reconnaissance mission, a PBM (Martin Mariner) type aircraft (fig. 151) attached to the U. S. S. *Pine Island* (seaplane tender) of the Western Group of the Task Force crashed and burned, killing three of the nine crew members. Shortly after completion of the rescue operations, it was found necessary to amputate both lower legs of one of the survivors (Lt. LeBlanc, U. S. N.) at the site of election. The combined effects of freezing and fire resulted in a dry gangrene of sufficient magnitude to necessitate the operation. The following account of the search and rescue operations is derived from messages received aboard the U. S. S. *Mount Olympus* of the Central Group, Flagship of the Task Force, located approximately 1,800 miles west of the U. S. S. *Pine Island* at the time of the crash.

Position of U. S. S. *Pine Island* at time of take-off of missing aircraft PBM-1:

Latitude 66° 30' S.

Longitude 98° 00' W.

Take-off time: 301040Z (Dec 1946).

ETA U. S. S. *Pine Island*: 302040Z

Nine crew members aboard aircraft.

Purpose of flight: Photo reconnaissance.

Fuel supply: For 20 hours of flight.

Estimated position 301225Z: Lat. 71° 22' S., long. 99° 20' W.

Last msg. received from missing aircraft:

TWO AND A HALF HOURS AFTER
TAKE-OFF. TRUE COURSE 180
DEGREES.

GROUND SPEED 118 KNOTS. AIR-
SPEED 130 KNOTS. ZERO DE-
GREES DRIFT.

600-1,000-FT. CEILING. WIND
SOUTH 11-16 KNOTS.

Code:

All times in Zebra.

PBM-1: crashed aircraft.

PBM-2: search and rescue aircraft from
U. S. S. *Pine Island*.

PBM-3: search and rescue aircraft from
U. S. S. *Pine Island*.

Due to bad weather searching flights were not possible until 6 January 1947. On this



Figure 151. Navy type PBM (Martin Mariner) aircraft.

date one PBM took off from U. S. S. *Pine Island* on searching mission but results were negative.

The second flight for this same purpose was made on the day the crashed aircraft and survivors were located as related in following account of rescue operations: January 1947:

- 111300Z PBM-2 (departed U. S. S. *Pine Island* (seaplane tender) on search for missing aircraft.
- 111729Z PBM-2 reports burned wreckage and alive men at 71° 03' S., 98° 47' W.
- 111732Z Five men alive.
- 111745Z Dropping survival gear by parachute.
- 111748Z Lopez, Henderson, and Williams dead. Six alive and on feet. Plane disintegrated and burned.
- 111823Z PBM-3 ready for flight to join PBM-2. Plane contains extra set JATO bottles in electrically heated jackets, large quantity dye markers and flags for marking trail, and additional aerial delivery survival equipment.
- 111858Z Crashed aircraft on edge of land 10 miles from open water. Suitable to land PBM in open water.
- 111958Z PBM-3 departed U. S. S. *Pine Island* with two PhM/1c (Pharmacist Mate 1st class) on rescue mission.
- 111959Z Survivors communicating with PBM-2 by visual signals. Survivors advised that PBM-3 enroute and bringing adequate emergency radio equipment to be dropped by parachute.
- 112159Z Survivors departed crashed aircraft and walking 10 miles toward open water where rescue will be effected.
- 112342Z PBM-2 returning to U. S. S.

Pine Island due shortage fuel. Permission granted PBM-3 to land in open water to effect rescue of survivors.

- 120113Z PBM-2 returned to U. S. S. *Pine Island*.
- 120149Z Following information derived from PBM-2 crew: PBM-1 crashed and burned. Port engine 15 feet ahead of fuselage. Starboard engine ahead of plane in snow. Wings off. Fuselage broken in two near forward bunk room. Fuselage 60 percent burned amidship. Tail section crumpled. Wing tip floats and struts scattered over 150-yard radius. Survivors apparently living in forward compartment of fuselage using parachute silk for additional tent material. Appearance of sled and paint indicates food was salvaged. Believe no radio equipment was salvaged. Six men first sighted standing around fire waving flags and rubber life raft. On starboard wing tip, "Lopez, Henderson, Williams dead" in yellow paint noted. Survivors were informed open water adequate for landing PBM aircraft 8 miles north of their position. Further advised that trail leading to open water would be marked for them from airplane. Advised to join hands if this message was understood. Survivors joined hands and stood on their heads to indicate they understood. Five of survivors observed walking, one being dragged on sled. At 112220Z when PBM-2 departed survivors for U. S. S. *Pine Island*, survivors had made good one-quarter distance to coast and open water.

120204Z Plane crashed on Barrier of Thurston Peninsular at 1,000 feet altitude on course 130° true.

Note. Following survival equipment parachuted to survivors from PBM-2 prior to return of aircraft to U. S. S. *Pine Island*:

FIRST CARTON

Item	Unit
Coleman heater.....	1
Cans safety fuel.....	2
Pyrotechnic projector.....	1
Dye marker.....	1
Box matches.....	1
Goggles, pairs.....	6
Rations, emergency cans.....	74
Ammunition, rounds.....	100
Nestles, large box.....	12
Cigarettes, carton.....	7
Whiskey, quart.....	2
Acid, ascorbic tablets.....	900
Vitamin, tablets.....	500
Sulfadiazine, tablets.....	300
Compass, wrist.....	2
Knife, sheath.....	1
Cooker, pressure.....	1
Aspirins, bottle.....	1
Surgical kit.....	1
Rifle.....	1

SECOND CARTON

Item	Unit
Rations, life raft and boat.....	1 can
Blankets.....	4

THIRD CARTON

Item	Unit
Socks, heavy.....	9 pr.
Masks, face.....	5
Mittens, leather.....	9 pr.
Mittens, wool.....	9 pr.
Underwear, heavy.....	9 suits
Books, pocket.....	8
Toilet paper.....	4 rolls

FOURTH CARTON

Item	Unit
Gasoline.....	5 gal.

FIFTH CARTON

Item	Unit
Tent, two-man.....	1
Tent, pup.....	1
Shovels, snow.....	2
Thread line, 15-pound.....	100 feet

120207Z PBM-3 landed in vicinity of survivors in open water mentioned in above dispatch from PBM-2.

120227Z Two crew members departed from PBM-3 in life raft for shore. Aircraft standing by in calm water. Weather perfect.

120437Z PBM-3 on water took six sun shots, reported PBM-1 crashed approximately 20 miles from last plotted position when radio failed. Barrier edge 10 feet high. Lined with inquisitive penguins.

120552Z Survivors approximately 2 miles from coast. Slow progress due rough terrain.

Note. Additional information derived from PBM-2 crew following return to U. S. S. *Pine Island*:

111629Z Wreckage sighted. Survival gear dropped before ground route to water edge decided upon. Plane looked as though it had skidded approximately 100 yards in snow. PBM-2 plotted safe course to water's edge for survivors by dropping eight flags and four dye markers to indicate northward course. Survivors told to take time and conserve energy while proceeding to open water. Survivors set out at brisk pace with occasional stops for rest. Route to water edge mostly downhill. Survivors following trail perfectly until time PBM-2 had to leave scene due to fuel shortage.

120454Z PBM-3 finds it necessary to taxi plane occasionally to prevent thin scum of ice forming around aircraft while awaiting survivors.

120614Z Lt. Comdr. Howell and PhM/1c Conger waiting on beach for arrival of survivors.

121250Z Survivors aboard PBM-3.

121335Z Survivors and injuries as follows: Caldwell, fractured nose; LeBlanc, face, hands, legs badly burned;

Kearns, fractured right humerus, McCarty, laceration of scalp; Robbins, O. K.; Warr, laceration of scalp.

121424Z PBM-3 airborne with survivors and all hands aboard.

121643Z PBM-3 landed alongside U. S. S. *Pine Island*.

Note. Report of events leading up to crash (as told by Lt. (jg) Kearns, who was at controls at time of crash):

Immediately after number 7 track report Cape Dart, sighted one point on port bow, distance about 12 miles. Radar unreliable. After sighting land, changed course from 180° to 160°. Increased altitude from 600 to 1,000 feet. At this time sighted land dead ahead on starboard bow, with ceiling on mountain tops. Numerous snow squalls. To avoid flying into mountain, change course to 090°. On east heading, no distinguishable horizon. Snow blended into overcast. Appeared as though plane flying into clouds. Plane put into shallow left turn and suddenly struck snow ledge. Plane bounced into air and full power was applied to engines. Plane was then flying under control. Plane put into further left turn to set course for U. S. S. *Pine Island* when suddenly plane exploded in air. Time element between striking ridge and explosion about 3 seconds. Believe friction on bottom of hull tank exploded gas in hull tank. Plane disintegrated in air as follows:

a. Both wings, connected together, were separated from fuselage in air following explosion.

b. Fuselage blown apart in air and separated aft of aft deck. Forward section headed north 40 feet west of aft section.

c. Wings, still held together, landed 80 feet west of aft fuselage in new direction.

d. Port engine landed 16 feet ahead of aft section fuselage.

e. Starboard engine landed 18 feet west of wings. Wing tip floats and struts scattered about wings. Various parts of plane scattered over 100-yard area.

f. Gasoline fire around forward section burned for about an hour, wing tanks burned, bomb bay tanks scorched but not burned. About 600 gallons of gasoline in bomb bay tanks available and later used for cooking.

Note. Position of men in plane and what happened to them when plane crashed is described as follows by Lts. (jg) Kearns and Warr:

a. Capt. Caldwell, in bow, was thrown backward by impact and then thrown clear of plane.

b. Lt. (jg) LeBlanc was strapped into seat and was rendered unconscious by striking head against throttles. He remained in burning cockpit until removed by Lts. Kearns, Robbins, and Warr. LeBlanc's clothing was on fire at this time. Entire pilot's cockpit was in flames. Kearns unfastened LeBlanc's safety belt and Robbins and Warr brought LeBlanc from the burning plane.

c. Lt. (jg) Kearns in co-pilot's seat and in control of the aircraft did not have his safety belt secured and was thrown clear of the cockpit through the windshield.

d. Robbins, ARM/2c (aviation radioman, second class) at his position by the radar screen was thrown clear of the plane.

e. Ensign Lopez, at the navigator's table, was killed instantly.

f. Henderson, ARM/1c (aviation radioman, first class) was at the radio panel and was killed instantly and thrown clear of the plane.

g. Williams, AMM/1c (aviation machinist mate, first class), standing at flight engineer's panel, was thrown clear of plane, but died from multiple injuries approximately 2 hours later.

h. Warr, AMMAC/2c (aviation machinist mate, combat crewman) was at flight engi-

neer's control panel. His safety belt was not secured and he was thrown clear of the plane.

i. McCarty, CPhoM (chief photographer's mate), was at his station in tunnel of plane. Was rendered unconscious but recovered sufficiently to drag himself from tunnel to waist compartment after crash. Further questioning revealed that top of forward fuselage section was blown off.

Note. Following information disclosed by Lt. Comdr. Howell, pilot of PBM-3 which returned survivors to U. S. S. *Pine Island*:

PBM-2 was directed to return to the U. S. S. *Pine Island* before PBM-3 arrived over the survivors. This was due to fuel shortage of PBM-2. PBM-3 navigation problem to location of survivors made easy by information supplied by PBM-2 on position of crash. Arrived over survivors 35 minutes after PBM-2 had departed. Survivors first seen by PBM-3 one-quarter distance from crashed plane to open water. Five men were observed to be dragging sled. Several passes were made between survivors and evacuation point. Survival gear, along with "Walkie-Talkie" radio was parachuted along route. Thirty-five American flags on metal shafts and twenty-two dye markers were dropped along route to mark route. It was learned later that flags on staffs made good markers but only one dye marker was seen by the survivors. Survivors instructed, visually, to continue on marked course to water's edge. PBM-3 then landed to conserve fuel. Comdr. Howell and Conger rowed ashore in a seven-man life raft with selected survival gear and twenty-five additional flags for markers. Barrier edge at this point was 1 to 25 feet high. Landing was easily effected on low barrier using alpine stocks as ice anchors. The sled and raft were then dragged to a safe distance on the ice. Survivors were sighted 4 miles inland on a high ledge or slope. Comdrs. Howell and Conger started toward the survivors, dragging the sled and equip-

ment. They attracted the survivors' attention by shooting off Very pistols and shouting. Survivors had "Walkie-Talkie" radio but couldn't use it. Upon arrival of all at water's edge, plane could not be seen due to fog which had set in. Comdr. Howell attempted to send up balloon with antenna for Gibson Girl, but due to cold air, could not get sufficient gas into balloon. No wind for kite. Managed to get "Walkie-Talkie" working just as plane came into sight. Three raft trips were necessary to evacuate survivors and survival gear from shore to aircraft.

Note. Following stated by Capt. Caldwell (Commanding Officer U. S. S. *Pine Island*, and one of six survivors of crashed aircraft):

Every part of the aircraft and everything else was utilized during our daily existence. The first 2 days the weather was very bad, with snow storms and high winds from the south. Visibility was zero-zero. We lived in the tunnel section of the aft fuselage section. This was the only protected compartment. All were injured or suffering from shock. All the men wanted to do was sleep and rest. No effort was made to break out the sleeping bags until the third day. No one ate anything for the first 1½ days—just lay around in a dazed condition. Passage of time was not realized. The correct time and date was later realized by an 8-day clock on the pilot's instrument panel. About 312100Z Robbins started moving around and aroused Warr. The two men headed for the galley in the forward section of the fuselage looking for something to eat. First food found was some canned apricots that were not frozen. This was opened and taken to the tunnel section where it was shared among all, each receiving two and one-half apricots. Rations were established at two meals per day. Nothing else was eaten that day or night. All rested and slept that night and until the following morning, which was New Year's Day. On this day, each man had a cup of

hot spinach soup. New Year's day supper consisted of one cup of hot chicken soup, one slice of bread and peanut butter per man. Reduced rations continued. First 5 days were passed resting, sleeping, eating, and searching for more food that was scattered throughout the area. Ninety percent of the food that was aboard was found and was usable. During the 2 weeks of isolation the men subsisted entirely on canned goods, fresh meat, and bread that were carried in the plane. One hundred and eighty pounds of pemmican and 350 cans of life raft rations were held in reserve and used only experimentally. The men liked the pemmican when mixed as a hot soup. Meat, potatoes, and pemmican when mixed as a stew was pronounced excellent. Everything in the life raft rations was liked and enjoyed by all. Cigarettes and candy in personal bags were considered a treat. On the sixth day, two two-man tents were erected between two sections of the fuselage. Robbins and Warr shared one tent. Capt. Caldwell and McCarty shared the other. Lt. Kearns and Lt. LeBlanc continued living in the tunnel, Kearns administering to needs of LeBlanc, who was not able to get about. The dead were buried under the south edge of the wing on the seventh day. An American flag was raised in their honor. Appropriate ceremonies were held with all present. Water was obtained by melting ice which had formed along the fuselage. Ice was melted only when meals were cooked. Cans of snow in the tents melted into water during the day. Efficiency of melting snow was much less than melting ice. No one suffered from lack of food or water.

Note. Communications observations:

Gibson Girl radio was put into operation within 1 hour after the crash. Antenna erected by using box kite. However, the kite was blown away during the first night by high winds. It was left flying largely due

to inability of men to haul it in. A new antenna was fashioned and erected and stretched between the verticle stabilizer and the empennage section, to the IFF starboard antenna, on starboard wing and operation of the Gibson Girl continued. Two RAX type receivers were located in the crash area. Using parts from both, one was put into operating condition, but due to insufficient voltage from the aircraft storage batteries, this project failed. When the survivors had been located a quantity of flashlight batteries had been found and these were being prepared to add to the storage batteries for more power. All other radio and radar gear was destroyed in the crash and fire. The auxiliary power unit was destroyed beyond repair. No communications, other than visual were ever established between the survivors and search and rescue aircraft or any other agency. Visual signals from plane to survivors were made with the use of an Aldis Lamp with a white light, which was efficient. A lamp using a red light was ineffective. Dropping messages also proved to be effective. Communication was established by the aircraft's sending a message requesting a "yes" or "no" answer performed by the actions by the survivors. Radar reflectors were generously laid out and, coupled with the plane's surface, gave high hope to the survivors of being picked up at a distance of 70 miles. However, background of snow and land caused radar signal return negligible. Attention of searching aircraft was attracted by filling rubber life raft with paper, cartons, pieces of Manila rope, pieces of parachute, small pieces of wood, and gasoline and setting fire to all of this. This made an effective pillar of smoke that, with no wind at the time, reached a height of 300 feet. The pilot of the searching aircraft PBM-2 which first sighted the survivors states that neither the survivors nor the crashed plane would have been seen if this smoke signal had not been made.

Note. Medical observations:

No medical supplies could be found at the time of the crash. Seven days later sulfadiazine tablets and sulfanilamide crystals were found. LeBlanc was given one sulfadiazine tablet every 4 hours thereafter. McCarty and Warr were treated for their lacerations by applying sulfanilamide crystals to their wounds. No severe loss of blood was noted, as the blood coagulated rapidly due to the low temperatures. Enough food was available to afford sufficient diet. The major part of the medical supplies was damaged in the fire. Normal amount of medical supplies and equipment carried in aircraft is considered adequate.

Note. Flora and fauna observations:

Flora and fauna were found to be practically nil. Five unidentified birds were seen by the survivors for a period of 3 days. On the coast, at the edge of the ice 20 Emperor Penguins were seen. Adelie Penguins were seen in the water and on ice floes. No vegetation was seen. Only exposed land seen was on mountain tops in the distance.

3. The second aircraft accident, resulting in the total loss of a HO3S-1 helicopter but with no injury to personnel, occurred in operations from the aircraft carrier U. S. S. *Philippine Sea*, attached to Task Group 68.4. The following is the official aircraft accident report:

21/GTG/rf/al
c/o Fleet Post Office,
New York, N. Y.
25 January 1947

A9

FIRST INDORSEMENT TO

Aircraft Accident Report

Serial 1-47

From: Commander, Task Group 68.4

To: Chief of the Bureau of Aeronautics.

Via: Commander Task Force 68.

Subject: U. S. S. PHILIPPINE SEA (CV-47) A.A.R. 1-47.

1. Forwarded, concurring in the findings of the board.

CERTIFIED A TRUE COPY:

D. S. CORNWELL

MURRAY A. WIENER,

Capt., Air Corps

AIRCRAFT ACCIDENT REPORT

NavAer Form 339 (Rev. 11-45)

U. S. S. PHILIPPINE SEA

Serial 1-47

Unit to which aircraft assigned: Base Group, Task Force 68.

Operating from: U. S. S. *Philippine Sea* (CV-47).

Time investigators arrived at crash: 1015, 22 Jan 47.

Unit submitting report: U. S. S. *Philippine Sea* (CV-47).
 Aviation chain of command of unit to which aircraft assigned: CTF 68.
 Unit to which pilot attached: Base Group TF 68.
 Date of accident: 22 January 1947.
 Hour (Local Time): 1002.
 Location of accident: Latitude 59-33 S., Longitude 155-24 W.
 Purpose of flight: Ice reconnaissance.
 Pilot's total time: 2,240 hours.
 Pilot's total time this model: 20 hours.
 Hours preceding 3 months: Total—30; this model—20.
 Time in flight before accident: 0 hours, 4 minutes.
 Ceiling: 4,000 feet.
 Visibility: 15 miles.
 Crosswind: Right 22 degrees.
 Wind force across deck: 12 knots.
 Darkness: No.
 Weather at time of accident: Contact.
 Aircraft Model: HO3S-1.
 Bureau Number: 57997.
 Did fire follow impact? No.
 Maneuver involved: Take-off.
 Altitude of maneuver (relative to water): 60 feet.
 Angle of impact: Vertical descent.
 Stopping distance: (0).
 Speed on impact: (0) knots.
 Personnel on board: Three.

<i>Name</i>	<i>Status</i>	<i>Position</i>	<i>Injuries (class)</i>
TANNER, Charles S., Lt. Comdr., U. S. N.	Pilot..	Cockpit..	D.
NYBERG, Arthur D., AMM/1c, U. S. N.	Crew .	Cockpit..	D.
KELSO, Charles E., S/1c, U. S. N.	Crew .	Cockpit..	D.

Is NAVAER Form 339B being submitted on the accident? No.

Classification of accident:

Nature: JT.

Results Personnel: D.

Results Material: A.

Description and analysis of accident:

Upon taking off the plane ascended slowly to a height of about 20 feet above the flight deck and hovered there for approximately 2 minutes. The plane then appeared to drift to the port side of the ship, and made a 150° turn. Upon completion of the turn the plane nosed down and gained forward motion. Just before reaching the water the plane appeared to level off and hover for about 10 seconds before splashing.

In view of the fact that none of the members are familiar with helicopter flight characteristics, the board does not consider itself qualified to make an analysis of the accident.

Aircraft and engine data:

	<i>Aircraft</i>	<i>Engine</i>
Model	HO3S-1	R-985
Bureau No.	57997	24822

Material damage: Strike; plane sank.

Material factors involved in this accident: Unknown.

Is an RUDM being submitted? No.

Special equipment: Life jackets.

Effectiveness of special equipment: Kept crew afloat.

Disposition of material: None salvaged.

Recommendations for local action: None.

Recommendations of general interest: None.

The above are true findings, based on a thorough investigation, mature deliberation, and thorough review of ACL 119-45.

H. M. KEISTER

A. JOHNSON

J. M. WESOLOWSKI

Enclosure: Pilot Statement.

Distribution: Original—BUAER via (1) CTG 68.4 (2) CTF 68.

4cc —BUAER direct.

1cc —COMAIRLANT.

Forwarded in accordance with paragraphs 4 and 11 of ACL 110-45.

Local action and general recommendations: None.

W. M. HAWKES,

Comdr., U. S. N.,

Commander, Task Unit 68.5.1

Pilot's Statement in Ditching and Loss of HO3S-1, Bureau Number 57997

The plane was loaded well within the C. G. limits. The load consisted of two passengers whose average weight was 150 pounds, one life raft that weighed approximately 30 pounds, and my weight of 150 pounds. A full gas load of 100 gallons was aboard.

On turning up the engine, the mags checked satisfactorily and all engine instruments indicated normal engine operation. Prior to take-off I set my carburetor air heat to prevent ice. This can be done in a helicopter by turning up the engine to the maximum r.p.m., setting the carburetor air indicator to the desired temperature, and leaving the control in that

position. By doing this you are assured of no ice on take-off plus the knowledge that the engine won't detonate since the carburetor air heat is set while the engine is at take-off r.p.m.

The plane was sitting just aft of No. 1 elevator headed forward. The relative wind was off the starboard bow at about 12 knots. I took off and hovered at about 10 feet above the deck to acquaint myself with the pitch of the ship and double check my engine. I then turned toward the port side of the ship with the intention of climbing and heading aft into the true wind.

On leaving my ground cushion, by flying off the port side of the flight deck, I expected to lose a little lift which should have been compensated for by gaining speed and adding more pitch. However, after flying off the flight deck cushion the plane immediately dropped down to the water despite the fact that I had applied full pitch and had approximately 2,400 r.p.m. All this time I had good directional control but the plane would not lift. It hovered over the water for a few seconds and then started to settle in. When I saw that it was going in, I ditched according to prescribed doctrine for this type of plane, i.e., "Ditch to starboard with passengers, to stop main rotor and use port hatch by passenger seat for escape." Both passengers escaped easily. Due to the inrush of water through the door, I was unable to clear the plane until the cockpit was full. We were in the water hardly more than 10 minutes before the ship's boat rescued us.

G. S. TANNER,
Lt. Comdr., U. S. N.

4. The third aircraft accident, resulting in the total loss of a second helicopter but with no injury to personnel, occurred in operations from the U. S. S. *Pine Island* (seaplane tender) attached to the Western Group. The following report from the U. S. S. *Pine Island* to the Commander, Task Force 68, U. S. S. *Mount Olympus*, Central Group, was received by wireless:

Subject: Aircraft Accident Report. (Re Helicopter attached to U. S. S. *Pine Island*, Eastern Group, Task Force 68.) (Report received by wireless from CTG 68.3 (U. S. S. *Pine Island*) to Commander Task Force 68, U. S. S. *Mount Olympus*, Central Group.)

Date: January 1947.

Position: Latitude 68° 10' S., longitude 105° 32' W.

192000Z: Helicopter took off on ice reconnaissance with good visibility and unlimited ceiling.

192057Z: Helicopter made higher than normal approach for landing because of suspected icing of main rotor blades. About 100 feet downwind from landing deck helicopter began to settle. Pilot applied full power and maintained forward speed, but settling continued. Helicopter turned away from ship in effort to regain speed and avoid hitting ship. Plane settled into water. No injuries to personnel. During period of flight weather deteriorated to low clouds and fog, through which helicopter was forced to fly in order to return to

ship. Excessive vibration indicated icing in view of fact blade test indicated perfect tracking prior to take-off. Helicopter total loss. Pilot and passenger

taken aboard crash boat within 1 minute after helicopter hit the water.

Note. This helicopter was rigged with wheels.

SECTION III. Search and Rescue Equipment

Since Army Observers were attached to the Central Group of Task Force 68, it was not possible to observe utilization of available search and rescue equipment or other equipment available for these operations within the Eastern and Western Groups of the Task Force. However, a list of available search and rescue equipment for both these groups is listed below for the reader's information. Detailed observations are herein described for the Central Group only.

1. Ships.

a. Eastern Group:

U. S. S. *Pine Island* (AV-12), seaplane tender.

U. S. S. *Brownson* (DD-868), destroyer.

U. S. S. *Canisteo* (AO-99), tanker (fig. 152).

b. Western Group:

U. S. S. *Currituck* (AV-7), seaplane tender.

U. S. S. *Henderson* (DD-868), destroyer.

U. S. S. *Cacapon* (AO-52), tanker.

c. Carrier Group:

U. S. S. *Philippine Sea* (CV-47), aircraft carrier.

d. Central Group:

U. S. S. *Mount Olympus* (AGC-8), flagship, Task Force 68 (fig. 153).

U. S. S. *Yancey* (AKA-93), supply ship.

U. S. S. *Merrick* (AKA-97), supply ship.

U. S. S. *Burton Island* (AG-88), ice breaker.

U. S. C. G. *Northwind* (WAG-282), ice breaker (fig. 154).

U. S. S. *Sennet* (SS-408), submarine (fig. 155).

e. Since all exploratory flights (PBM Martin Mariner aircraft) of the Eastern and Western Groups originated north of the ice pack, from individual tenders, it was necessary for these aircraft to fly over water as well as sea ice en route to the Antarctic Continent, the operational area assigned to the entire Task Force. In accordance with these flight routes, each and every ship was at all times available for immediate emergency operations within the scope of their navigational possibilities. However, since neither the Eastern nor Western Group had an ice breaker assigned to it, it is doubtful that the ships of these groups could have effected a rescue within or south of the ice pack without additional aid. Other than an open water



Figure 152. U. S. S. *Canisteo* (tanker).

rescue operation north of the ice pack, both these groups had to depend entirely on their air operations for search and rescue emergencies.

2. Aircraft.

a. Eastern Group.

- 3 ea. PBM (Martin Mariner).
- 1 ea. HO3-S (helicopter).
- 1 ea. HOS (helicopter).
- 1 ea. SOC (seaplane).

The above listed aircraft were attached to and operated from the U. S. S. *Pine Island*.

b. Western Group.

- 3 ea. PBM (Martin Mariner).
- 1 ea. HO3-S (helicopter).
- 1 ea. HOS (helicopter).
- 1 ea. SOC (seaplane).

The above listed aircraft were attached to and operated from the U. S. S. *Currituck*.

c. *Carrier Group.* The Carrier Group consisted only of the aircraft carrier, U. S. S. *Philippine Sea*. The sole purpose of this ship within the phase of operations of the Task Force was to transport six R4D ski-wheel equipped aircraft to the northern edge of the Antarctic ice pack and from that position launch subject aircraft for flights to the base camp on the Ross Shelf Ice at Little America IV. These aircraft, upon completing this epoch-making flight, became a part of the Central Group (as shown below), based and operating from Little America IV, on the Ross Shelf Ice. In addition, at the time of the R4D launchings, two OY (Army L-5) type aircraft were transferred from the U. S. S. *Philippine Sea* to the U. S. C. G. *Northwind* (ice breaker) for further transportation through the ice pack to the site of the base camp of the Central Group.

d. Central Group.

- 6 ea. R4D (C-47), ski equipped.
- 1 ea. JA (Army C-64 Norseman), ski equipped.



Figure 153. U. S. S. Mount Olympus, flagship of Task Force 68, shown nosing into the bay ice in the Bay of Whales.

- 2 ea. OY (Army L-5), ski equipped (fig. 156).
- 2 ea. HOS (helicopters).
- 2 ea. J2F (seaplane).

Note. The JA (Norseman) type aircraft was transported from the United States to the Ross Shelf Ice aboard the U. S. S. *Mount Olympus* (fig. 157). This aircraft was the only aircraft within the Task Force designated primarily for search and rescue operations. The two OY type aircraft were a last minute addition to the Task Force. Since this addition was made after writing and publication of the Task Force plan of operations, no mention of these aircraft will be found in the operation plan. Both aircraft were available for search and rescue operations and had been modified to carry one stretcher case within the fuselage.

One each HOS (helicopter) and J2F (seaplane) were attached to and operated from the ice breakers U. S. S. *Burton Island* and U. S. C. G. *Northwind*. Although past utilization of helicopters in rescue operations has proven highly advantageous and successful within limited operations and conditions, these craft, as well as the J2F aircraft, were



Figure 154. U. S. C. G. Northwind (ice breaker) opening leads for passage of larger supply ships. Note J2F aircraft and helicopter on landing deck aft.

Figure 155. U. S. S. Sennet (submarine) taking refuge in open water deep inside the ice pack. The Sennet was compelled, due to heavy ice, to return north of the pack.





Figure 156. Army L-5 aircraft on skis. This aircraft was modified to carry one stretcher patient within its fuselage and was available for search and rescue operations.



Figure 157. Army type C-64 (Norseman) aircraft loaded on deck of U. S. S. "Mount Olympus" for transport from the United States to Antarctica.



Figure 158. Navy R4D (Army C-47) type aircraft on flight deck of U. S. S. *Philippine Sea* (aircraft carrier) prior to take-off from ship to Little America. Note ski-wheel combination, necessary for take-off from flight deck and landing on snow surface at Little America.

primarily used for scouting the ice pack for leads to insure successful navigation of the larger vessels, as well as the ice breakers. Due to unforeseen conditions, as mentioned elsewhere within this publication, it was not possible for either of the ice breakers with their assigned aircraft to remain in the vicinity of the Ross Shelf Ice during the entire period of aircraft operations from

Little America IV. However, during the flight of the six R4D aircraft from the aircraft carrier U. S. S. *Philippine Sea* (fig. 158) to Little America, the U. S. C. G. *Northwind* stood by in the ice pack, along the flight route, sending weather information to the aircraft carrier and her aircraft, at all times available for immediate emergency operations and should any of the flights make emergency landings on the sea ice or open water, short of their destination.

3. Over-Snow Vehicles.

a. Since neither the Eastern nor Western Groups maintained a base camp on the Antarctic Continent, ground or over-snow type vehicles were not included among their individual equipment.

b. The following over-snow vehicles were available for emergency rescue operations at the base camp of the Central Group:

- 7 ea. Army M-29C (Weasel) with 20-inch tracks (fig. 93).
- 2 ea. LVT (landing vehicle, tracked) (fig. 128).

4. Dogs and Sleds.

27 ea. dogs, sled (3 teams, 9 dogs each).

4 ea. sled, dog, cargo, with gee pole.

5. Emergency Drop Kits.

There were no emergency aerial delivery kits other than rations which were carried in aircraft on operational missions (see par. 6) prepared and available for immediate use.

6. Emergency Survival Equipment.

a. Eastern Group. The following listed rations and first aid and emergency survival equipment were carried on PBM (Martin Mariner) aircraft operational flights, with crew of nine:

Item	Amount
Salt.....	2 lbs.
Pepper.....	1 lb.
Sugar.....	5 lbs.
Coffee.....	5 lbs.
Milk, powdered.....	2 lbs.
Peanut butter.....	7 lbs.
String beans.....	7 lbs.
Potatoes.....	5 lbs.
Beets.....	7 lbs.
Bread.....	4 lbs.
Butter.....	2 lbs.
Apricots.....	7 lbs.
Ham.....	11 lbs.
Bacon.....	5 lbs.
Beef.....	8 lbs.
Jam.....	8 lbs.
Soup.....	14 lbs.
Salad oil.....	1 gallon.
Pickles.....	1 lb.
Mustard.....	1 lb.
Eggs.....	24 each.

In addition to the food listed above, there were 150 pounds of pemmican and 1,050 cans of tablet rations.

Aircraft Emergency Survival Equipment

Item	Amount
Reflector, corner, radar.....	2 each
Sled, man-haul, 2-man.....	1 each
Tent, Arctic, 5-man.....	1 each
Tent, Arctic, 2-man.....	4 each
Kit, fishing.....	4 each
Machete.....	1 each
Shovel.....	1 each
Stock, alpine.....	2 each
Stove, Coleman.....	2 each
Lampblack.....	4 lbs.

Item	Amount
Line, 2-inch.....	200 feet
Gloves.....	9 pairs
Stockings, heavy.....	18 pairs
Paint, orange.....	1 gallon
Brush, paint, 4-inch.....	1 each
Matches.....	1 carton
Marker, dye.....	5 each
Creepers, ice.....	9 pairs
Shells, 12-gage.....	100 each
Shells, .22 cal.....	200 each
Life raft, Mark VII, complete.....	2 each
Bag, sleeping.....	9 each
Suit, exposure.....	9 each
Kit, first aid.....	6 each
Blanket, wool.....	3 each
Harness, parachute.....	9 each
Mae West.....	12 each
Can, safety, 5-gallon.....	1 each
Can, 1-gallon.....	2 each
Utensils, cooking.....	1 set
Utensils, eating.....	1 set
Water bag, plastic.....	28 each
Headnets.....	27 each
Cups, water, plastic.....	6 each
Marker, dye.....	12 each
Flashlight, w/batteries.....	9 each
Radio, "Gibson Girl".....	1 each
Shotgun, 12-gage.....	1 each
Rifle, .22 cal.....	1 each

First Aid Equipment

Scissors, 5½-inch.....	1 each
Tourniquet, field.....	1 pkg.
Tablets, sulfadiazine.....	8 each
Ointment, boric acid, 1 oz.....	2 tubes
Dressing, first aid, small.....	1 pkg.
Dressing, bandage, comp., 4-inch.....	1 pkg.
Dressing, eye.....	1 pkg.
Adhesive strips.....	3 sets
Butyn sulfate (plus 2%) and metaphen....	1 tube
Iodine, mild tincture.....	10 minims
Dressing, first aid, large, field type.....	2 each
Sulfanilamide, 5 gr.....	2 pkgs.
Eyepad, cotton, sterilized.....	33 each
Ointment, boric acid, eye.....	2 tubes
Tablet, halazone.....	100 each
Handitape, sterilized, plane, 1 x 3⅝"....	16 pieces
Syrettes, morphine tartrate.....	2 tubes

b. Western Group. The following listed rations and first aid and emergency survival equipment were carried on PBM (Martin Mariner) aircraft operational flights, with crew of nine:

Item	Amount
Pemmican.....	180 lbs.
Ham, canned.....	12 lbs.
Spam.....	7½ lbs.
Tablets, malted milk.....	2 lbs.
Biscuits.....	8½ lbs.

Item	Amount
Tea.....	20 lbs.
Sugar.....	50 lbs.
Salad oil.....	23 lbs.
Beef, frozen.....	55 lbs.
Vegetables, canned.....	45 lbs.
Fruit, canned.....	48 lbs.
Crackers, soda.....	12 lbs.
Rice.....	50 lbs.
Fruit, dried.....	18 lbs.
Bouillon.....	12 lbs.
D-ration chocolate.....	9 lbs.
Peanut butter.....	14 lbs.
Raisins.....	21 lbs.
Soup, canned.....	24 cans
Ration, aircraft, emergency tablets.....	350 cans
Cheese, canned.....	12 lbs.
Salt.....	5 lbs.

Aircraft Emergency Survival Equipment

Suit, immersion.....	12 each
Bag, sleeping.....	12 each
Gloves.....	12 pairs
Stockings, wool.....	24 pairs
Tent, 2-man.....	6 each
Kit, fishing.....	1 each
Raft, 7-man.....	2 each
Machete.....	1 each
Shovel.....	1 each
Stock, alpine.....	2 each
Stove, Coleman.....	4 each
Lampblack.....	4 lbs.
Line, 2-inch.....	200 feet
Mae West.....	12 each
Utensils, cooking.....	1 set
Sled, man-haul, 2-man.....	1 each
Paint, orange, w/brush.....	1 gallon
Radio, "Gibson Girl".....	1 each
Matches.....	1 box
Rifle, Springfield, .30 cal.....	1 each
Shells, .30 cal.....	100 each
Saw, ice.....	1 each
Clothing, flight, extra set.....	1 per man
Blankets, wool.....	3 each
Harness and parachute.....	12 each
Can, 1-gallon.....	2 each
Implements, eating.....	1 set

First Aid Equipment

Stretcher, Stokes.....	1 each
Blankets.....	5 each
Splints.....	1 set

In addition to the above first aid equipment, there were 4 each, kits, first aid, each kit containing the following items:

Item	Amount
Bandage, compression, 2-inch.....	4 each
Bandage, triangular, 40-inch.....	1 each
Tube, ammonia.....	4 each
Compress, bandage, 4-inch.....	1 each
Ointment, burn.....	2 tubes

Item	Amount
Application, iodine.....	3 each
Dressing, battle, small.....	1 each
Tourniquet.....	1 each

Two each life raft first aid kits contained the following:

Item	Amount
Syrettes, morphine tartrate.....	1 tube
Sulfadiazine.....	1 pkg.
Ointment, boric acid.....	1 tube
Iodine, tincture of.....	1 each

One each emergency first aid box (sealed) contained:

Item	Amount
Cotton, absorbent, roll.....	1 lb.
Butyn sulfate and metaphen (eye ointment).....	2 each
Solution, boric acid.....	120 cc.
Dressing, battle, small.....	5 each
Gauze, plain.....	25 yards
Syrettes, morphine, ½ gr.....	5 each
Sulfate, benzedrine.....	2 boxes
Ointment, boric acid, 4-oz. tube.....	4 each
Tourniquet, web.....	3 each
Bandage.....	24 each
Applications, iodine.....	3 each
Tablet, Castrara.....	100 each
Tag, emergency medical.....	1 book
Pencil, skin, marking.....	1 each
Bath, eye.....	1 each
Dressing, battle, large.....	4 each
Dressing, head.....	1 each
Bandage, 2-inch.....	18 each
Brandy, bottle, 2-oz.....	10 each
Ointment, boric acid.....	1 lb.
Adhesive tape, 2-inch.....	2 rolls
Sulfanilamide.....	20 pks.
Aspirins.....	1 box
Inhalant, ammonia.....	20 each
Stick, application.....	1 roll
Splint, wire.....	1 each

c. *Central Group.* (1) The following list of emergency equipment was carried on the R4D (C-47) flights (crew of five) from the aircraft carrier U. S. S. *Philippine Sea* to the base camp of the Central Group at Little America:

Item	Amount
Life raft, 7-man.....	1 each
Bag, sleeping, Arctic.....	5 each
Suit, immersion.....	5 each
Clothing, emergency, personal.....	5 each
Mae West.....	5 each
Radio, "Gibson Girl".....	1 each
Rations, K.....	10 days each man

Note. Break-down of item, "Clothing, emergency, personal," is listed under (2) below.

(2) The following listed rations and first aid and emergency survival equipment were carried on R4D (C-47) ski-equipped aircraft operational missions.

Rations (One man for 60 days)	
Item	Amount (pounds)
Pemmican.....	15
Tea.....	1½
Milk, powdered.....	7½
Peanut butter.....	2
Cocoa, powder.....	1
Oatmeal.....	2
Cereal blocks ¹	3¾
Cocoa blocks ¹	3¾
Breakfast ²	30
Supper ²	30
Sugar, bulk.....	2
Cheese.....	3¾
Bacon.....	5
Biscuits.....	6½
Butter.....	4
Salt.....	1
Choc blocks ¹	2¾
Sugar blocks ¹	10
Dinner ²	30

¹ From Army E ration.

² From Army K ration.

One each of the above rations was carried for each crew member on operational flights.

Each individual ration was packed in an aerial delivery container, three of the containers having attached a 24-foot cargo type parachute for aerial delivery in case of an emergency.

Aircraft Emergency Survival Equipment

(Crew of six)			
Item	Weight (pounds)	No. Items	Total Weight (pounds)
Bag, sleeping, Arctic.....	14.0	6.....	84.0
Tent, mountain, two-man....	30.0	2.....	60.0
Sled, man-hauling.....	34.0	2.....	68.0
Harness, man-hauling.....	3.5	2.....	7.0
Sled, tank.....	7.5	2.....	15.0
Skis and bindings.....	10.5	6 pr...	63.0
Ski poles.....	1.5	6 pr...	9.0
Radio, Gibson Girl.....	35.0	1.....	35.0
Stove, Coleman, single burner	3.0	2.....	6.0
Cans, 5-gal. Blitz, with gas for stoves.....	43.0	3.....	129.0
Suit, windproof.....	2.4	6.....	14.4
Shovel, short handle.....	5.0	1.....	5.0
Panel, signal.....	2.5	1.....	2.5
Shovels, trail.....	2.0	1.....	2.0
Hammer, geologist's.....	1.0	1.....	1.0
Crampons.....	3.0	2 pr...	6.0
Flares, smoke, orange, hand..	....	8.....	2.0

(Crew of six)			Total Weight (pounds)
Item	Weight (pounds)	No. Items	
Compass, pocket.....	....	6.....	1.5
Glasses, sun.....	....	6 pr..	1.0
Saw, hand.....	1.5	1.....	1.5
Rope, alpine, nylon, 120 feet.	5.5	1.....	5.5
Stock, alpine.....	2.0	1.....	2.0
Mauls.....	12.0	2.....	24.0
Liners, parka, wool.....	1.0	6.....	6.0
Flag, trail marker.....	....	100..	10.0
Pot, cooking.....	....	1.....	20.0
Knives, sheath.....	....	2.....	
Bowls, wood.....	....	6.....	
Cups, plastic.....	....	6.....	
Spoons, wood.....	....	8.....	
Cans, fuel, sterno.....	....	6.....	593.0
Total weight.....			

In addition to the above list of emergency survival equipment, each crew member on each extended flight was required to carry the following list of personal emergency survival clothing:

Item	Amount
Liners, shoe, felt.....	3 pairs
Cap, knit, watch.....	1 each
Glasses, sun.....	1 pair
Mukluks, canvas (Army QM).....	1 pair
Booties, felt, mukluk.....	1 pair
Mittens, leather.....	1 pair
Socks, double sole, light weight.....	1 pair
Socks, wool (long top).....	2 pairs
Underwear, wool, heavy.....	2 pairs
Jacket, field, pile lined.....	1 each
Parka, Pile lined, inner.....	1 each
Mask, face.....	1 each
Mittens, wool, inner liners.....	2 pairs
Boots, ski.....	1 pair
Inner soles, mukluk.....	1 pair
Scarf, silk.....	1 each
Shirt, wool (Army O. D.).....	1 each
Socks, wool (short top).....	2 pairs
Trousers, wool (Army QM).....	1 pair
Sweater, wool, turtle neck (Army QM)...	1 each
Parka, windbreaker.....	1 each

First Aid Equipment

Item	Amount
Band-aids, 1 inch x 3¾ inches.....	16 each
Tourniquet.....	1 each
Pad, eye, cotton.....	2 each
Ointment, boric acid, ¼ oz.....	2 tubes
Ointment, boric acid, 1 oz.....	2 tubes
Tablets, sulfadiazine.....	8 each
Scissors.....	1 pair
Tablets, halazone.....	100 each
Iodine, swabs.....	10 each
Bandage compress, 4 inch.....	1 each
Strip, adhesive.....	3 sets
Ointment, ophthalmic, ¼ oz.....	1 tube

Item	Amount
Dressing, battle, small.....	1 each
Dressing, battle, large.....	2 each
Surettes, morphine, ½ gr.....	2 each

In addition to the above list of first aid equipment the following kit, first aid, pilot, was added:

Item	Amount
Bandage, gauze, roller, plain, 2 inches by 6 yards.....	12 each
Bandage, gauze, roll, 3 inches by 10 yards.....	12 each
Dressing, battle, large.....	4 each
Aspirin, 5 grain.....	50 each
Pamphlet, first aid.....	1 each
Gauze, surgical, absorbent, 36 inches by 25 yards.....	1 each
Syrettes, morphine, ½ gr. (5 in box).....	2 boxes
Tablet, sulfadiazine, 7½ gr. (100 in bottle).....	1 bottle
Ointment, boric acid.....	1 lb.

Note. Aircraft emergency equipment for ship-based aircraft, and the JA (Norseman) were as given in the operation plan (par 6b and c, sec. I).

Since the operations of the OY (Army L-5) aircraft were limited in range to sight of the base camp, emergency equipment was not carried in this aircraft.

7. Communications.

a. Air-Ground Portable Sets. There were available for emergency use several SCR-536 (Handy - Talky) radio sets. Occasional ground tests were made which showed shorter than normal distances operable. This was probably due to the fact that batteries available for this set were over-age, being dated 1944. No air-ground tests were, made nor were any of these sets equipped for aerial delivery.

b. M29C (Weasel). Only one of the seven available M29C vehicles were radio equipped, the set being an SCR-610 which was not suitable for air-ground communications as aircraft did not carry radio equipment which operated on the same frequency. However there was available for installation M29C radio equipment (SCR-694) which could have been supplemented for air-ground emergency operations.

c. LVT (Landing Vehicle, Tracked). The LVT type vehicles were equipped with Navy

type TCS (1.6 to 12 megs) radios. This type set proved satisfactory for air-ground communications and on an aviation gas cache laying field trip over 100 miles from the base camp at Little America this set proved adequate for communications between vehicles and the base camp.

Note. For further detailed information and discussion on aircraft, vehicle, and ground radio equipment, refer to chapter 8.

d. Additional Safety Precautions. (1) Since there were no personnel or equipment whose primary duty or function was for search and rescue operations, other than the JA (Norseman) aircraft, all operational flight and ground units (Weasels, LVT's, and dog teams) with their personnel would have immediately reverted to this status in case it became necessary to put emergency operations into effect.

(2) As an added safety, operational exploratory flights into the interior of the Antarctic Continent were made with flights of two aircraft (crew of 6 each), each carrying out his own individual mission and at the same time covering the other aircraft for any emergency landing away from the airstrip at the base camp.

(3) Still another precaution was taken in rigging three of the six 60-day individual emergency food rations (fig. 159) with 24-foot cargo parachutes for aerial delivery (par. 6c). It was planned that if one of the two aircraft made a forced landing, the second aircraft of the flight would immediately assume a rescue status and as such would not only fix the position of the downed aircraft and relay this information to the base camp, but would, as well, drop the three parachute equipped rations of food to the downed personnel, giving them food for six men for a period of 90 days instead of the 60-day ration carried in the aircraft. Half of all aircraft emergency rations were so rigged. This, however, would leave the second aircraft



Figure 159. Emergency rations and equipment being lashed down in C-47 prior to flight. Note corner of Tokyo tanks in foreground.

with only a 30-day ration for six men instead of the full 60-day period. It must be assumed, however, that the captain of the rescue aircraft, prior to dropping the three food rations, had no reason to believe that his aircraft would develop any difficulties serious enough to necessitate his also making an emergency landing, prior to doing all possible toward the rescue of the stranded personnel and the safe return of his crew to the base camp.

(4) This procedure might well seem an added hazard to the casual reader, and this observer will make no attempt to detract from that trend of thought. However, air operations, or air support to stranded personnel in the Antarctic is difficult under the very best conditions. The lack of weather information from many stations along or adjacent to a flight route automatically takes

a deep cut in the percentage of flying days into the interior. Although the decision of dropping half of one's emergency rations puts quite a responsibility on the skipper of the aircraft toward his crew, in this case it is a necessary one, for Antarctic weather has been known to be bad for weeks at a time, weather that would hinder search and rescue operations. This has been found true throughout the Arctic. This observer knows from past experiences in the Antarctic (Byrd Expedition, 1939-41) that it is more true in these southern latitudes.

(5) As air operations were to continue up until the actual date of evacuation of the ships and men from the base camp at Little America IV, such date being decided on by the condition of the ice pack and weather conditions in general, a winter party of 10 officers and 25 enlisted men had been selected and were prepared to remain to continue any search and rescue operations which might have been necessary after the date necessary for the evacuation of the Central Group.



Figure 160. Emergency camp built on top of Little America III (Byrd Expedition, 1939-41). Tops of buildings of old camp are below the surface.

(6) Buildings of Little America III, base camp of the United States Antarctic Service Expedition, 1939-41 located 2 miles south of the Central Group's base camp, were reinforced, food, medical, and radio supplies

were moved in, and in general prepared for immediate occupation. Since rescue operations were not necessary within the Central Group, it was not necessary to man this emergency winter camp. (See fig. 160.)

SECTION IV. Observations

1. Crash Team and Equipment.

At the site of the airstrip, base camp, Central Group only one M29C was utilized as "crash equipment." This unit comprised, in personnel, the Base Medical Officer and one pharmacist's mate who took up a position halfway down the airstrip on all take-offs and landings. Crash equipment, other than medical supplies, carried on a 1-ton Army sled behind the Weasel consisted only of several emergency fire-fighting bottles (fig. 170).

2. Dog Teams.

Results of utilization of the dog teams were practically nil, due in great part to the lack of training and experience of both assigned dog drivers and the dogs themselves. Three enlisted Navy personnel received a short training period in dog driving and handling prior to departure of the Task Force from the United States. However, this training period was not sufficient due to circumstances beyond control. Proficiency in the art of dog driving comes only with many months of training and actual trail experience. The dog teams were used, in some cases, for hauling cargo from the ships to the site of the base camp, a distance of about 2 miles. However, this simple task became a problem as lead dogs would not answer to commands nor stay to a trail. It was necessary at all times for one man to "break trail" and always remain in front of the dogs, leading and coaxing them on.

3. Dog Sleds.

Sleds were, in part, bolted together instead of lashed with the conventional rawhide. This detracted greatly from the flexibility of the sleds throughout. Although damage to the dog sleds was not great, probably due to the fine surface conditions prevailing in the vicinity of Little America and the minimum use they received, it is felt by this observer, experienced in this sort of operation, that on an extended trail journey, these sleds would not have remained in one piece very long.

4. Aerial Delivery Tests.

a. At the request of this observer, Captain Murray A. Wiener, and with the acknowledged aid of Marvyn D. Sprake, Parachute Rigger, First Class, U. S. N., two aerial delivery cargo tests were made.

b. The first test utilized a 24-foot Panatex Navy type Quick Attachable Chest Parachute, rigged with a 15½-foot static line of 1,400-pound tensile strength, attached to the pull handle by means of 5,000-pound tensile strength snaps.

c. The drop-kit container, carrying two 5-gallon "Blitz" cans filled with 72-octane gasoline, was attached to the parachute in the conventional manner. The only padding used in the container was 12 inches of felt in the bottom. The drop was made from an R4D (C-47) aircraft, flying at an altitude of 800 feet at a speed of 85 knots.



Figure 161. Results of unsuccessful aerial delivery cargo test, utilizing 24-foot Panatex Navy type quick attachable parachute. Cargo container buried itself 3 feet into hard snow (névé) surface. Parachute canopy did not open until unit was approximately 40 feet from surface.

d. The following observations were made concerning this test:

(1) The static line performed its function correctly; however, the parachute failed to "stream" or "open" until approximately 40 feet above the surface; it failed to function in any manner after the static line had pulled the rip cord. When the pilot chute finally worked itself clear, it was carried away while pulling the main canopy free.

(2) The drop kit buried itself 3 feet in the hard snow (névé) surface (fig. 161). The "Blitz" cans were undamaged, except for a slight dent in one can. No fuel was lost.

(3) The parachute failed to function because the canopy container failed to open after the rip cord had been pulled. The canopy container was manufactured by Panatex, this being the commercial name of a paint-impregnated canvas used extensively by the Navy for all types of parachute containers as parachute protection against salt water spray and other damaging conditions evident in sea operations. This

material, because of the presence of the paint, tends to harden and become brittle when exposed to low temperatures such as was recorded at the time of this test, -10°F . In the case of this failure the container had become so hard and brittle that the bungee cords could not pull back the container flaps and free the pilot chute and main canopy.

e. The second cargo parachute drop was made with an experimental 18-foot muslin "Baseball" type cargo parachute (fig. 162).

(1) The canopy of this parachute was of unbleached natural colored muslin. The container was of a plastic box type and the static line actuated.

(2) This drop was also made from an R4D (C-47) aircraft flying at an altitude of 800 feet at a speed of 85 knots. There was a ground wind of 1 to 4 knots variable and the temperature 0°F . The cargo container was loaded with two 5-gallon "Blitz" cans filled with 72-octane gasoline, giving a gross weight of 95 pounds.



Figure 162. "Baseball" type parachute and cargo container.



Figure 163. Sgt. S. A. London just prior to making parachute test jump. Note T/5 parachute assembly and static line.

(3) Two and one-half seconds elapsed from the time the unit was kicked from the aircraft to complete opening of the canopy. Forty-four seconds elapsed from the time of full opening until the unit reached the surface, a total of $46\frac{1}{2}$ seconds. No damage was noted to cargo kit or parachute. The kit made an impression in the hard snow (névé) surface 2 inches deep at one end, tapering to 7 inches at the opposite end. The approximate drift was estimated to have been 390 feet.

(4) The opening of this parachute was slightly eccentric, as the parachute made what appeared to be a complete oscillation before it fully opened. At the moment of opening, the kit itself was about 20 feet above the chute. It was later discovered that this was caused by the static line. The static line

on this type parachute is secured to the skirt of the chute rather than the apex. Only one oscillation was observed after opening.

(5) This parachute is delivered from the manufacturer in a ready-to-use waterproof container and may be stored for an indefinite period of time.

5. Personnel Parachute Jump Tests.

a. As this observer, S. A. London, 1st Sergeant, is an Army trained paratrooper, assigned to a search and rescue unit of the Army Air Forces, Air Transport Command, it was desired by him and Captain Murray A. Wiener, Army Air Forces, Air Transport Command, search and rescue observer, that personnel parachute jump tests be made. Permission for these tests was granted by the Commander, Task Force 68, at the request of Captain Wiener.

b. Three test jumps were made. One jump was made by a nonqualified, non-service-trained Navy enlisted man whose observations are not included here since his observations were practically nil due to his inexperience in parachuting. Parachute Rigger 1c Marvyn D. Sprake, U. S. N., has contributed to this report by submitting to this observer all his personal observations of a jump made on 21 February 1947. A jump was made by this observer on 4 February 1947. A full report follows.

c. Observations and notations of parachute jump made by S. A. London, 1st Sergeant, United States Army Air Forces, Air Transport Command, on 4 February 1947:

(1) Height of jump: 2,500 feet above the Ice Shelf. This height was chosen so that extended observations could be made while in descent.

(2) Type parachute used: T/5 assembly (28-foot main with 24-foot reserve parachute) (fig. 163).

(3) Weight of parachutist: 160 pounds without field equipment or added weight of any nature.

(4) Type of aircraft: R4D (C-47).

(5) Landing surface: wind-packed (névé) snow.

(6) Time: 1,800 hours local time. Latitude 78° 32' S. Longitude 163° 50' W.

(7) Wind: 25 miles per hour at 2,500 feet, 7 miles per hour at snow surface.

(8) Visibility: unlimited.

(9) Ceiling: unlimited.

(10) Temperature: -1° at 2,500 feet; $+5^{\circ}$ on the surface.

(11) Clothing worn: jacket, field, M1943 without liner; Army Air Force vest with hood; standard OD shirt and trousers; under-clothing, cotton; socks, wool, heavy; shoes, shoepak; glasses, sun—Air Force issue.

(12) After take-off the jumper removed the parachute jump door located within the cargo door on the after port side of the fuselage. One dry run was made over the Bay of Whales and Little America to familiarize the parachutist with surrounding terrain into which he would jump. It was particularly noticeable that the crisp, light air over the continent, at 2,500 feet, had an invigorating effect upon one. Much more so than comparable heights over warmer areas. At approximately 1801 hours (local time) the jump signal was received from the pilot. The jumper immediately stepped out into the on-rush of the propeller wash. The opening was felt about $2\frac{1}{2}$ seconds after stepping from the door of the R4D (C-47). The $2\frac{1}{2}$ -second opening was determined by counting as taught by the Airborne School, Fort Benning, Georgia. A steady wind of approximately 25 miles per hour, north to south, was found to be drifting the jumper from front to rear with considerable oscillation. By grasping the left forward riser and climbing it for approximately 10 feet a parachute turn of 180° was accomplished, this putting the wind to the back of the jumper. Several attempts were made to check oscillation, all of which proved successful, but



Figure 164. Sgt. S. A. London after parachute jump, showing depth of impact impression (approximately 2 inches).

oscillation soon started again. It was found that the parachute could be slipped in any direction with little difficulty. This factor, it is believed, can be attributed to the thin, light atmosphere. The rate of descent was slightly faster than normal, with this type chute, over warmer areas. However, landing body shock was found to be much less than normally encountered due to under-crust of snow and ice (fig. 164). Approximately 2 minutes and 20 seconds elapsed from the time of exit to surface landing. The parachute landing fall, as taught in the Airborne School, Fort Benning, Georgia, was used in the landing to determine the extent of shock absorption offered by the snow and ice surface. Body shock was nil in comparison to an earth landing.

d. Observations and notations of parachute jump made by Marvyn D. Sprake, Parachute Rigger 1c, U. S. N., on 21 February 1947:

- (1) Height: 1,500 feet above sea ice.
- (2) Parachute type: T/5 assembly—28-foot main canopy with 24-foot reserve.
- (3) Weight of jumper: 148 pounds without additional equipment.
- (4) Aircraft used: R4D (C-47).
- (5) Speed: 85 knots.
- (6) Landing surface: névé snow.
- (7) Time: 1400 hours Little America time.
- (8) Wind: 1,500 feet, 36 knots; on surface 20 to 25 knots east to west. Aerology had reported prior to take-off, 10 knots at 1,000 feet and 1 to 5 knots variable on surface.
- (9) Visibility: 12 miles.
- (10) Ceiling: 5,000 feet.
- (11) Temperature: -5° F.
- (12) Clothing: woolen underwear; OD shirt and trousers; field jacket, M1943 without liner; two pairs ski socks and shoepaks; gloves, Navy intermediate flying; goggles, Navy N-2 modified by cutting additional vents to forestall fogging.
- (13) Immediately after taking off I assisted the crew chief in the removal of the jump hatch. A dry run was made to acquaint the pilots with the desired course and exit point. Neither the pilot nor co-pilot had ever dropped either cargo or personnel before; however, I had briefed both before leaving the ground as to altitude, direction, speed, etc. On the second run while standing in the door I noticed that the tips of my fingers on both hands had become quite cold and were beginning to feel slightly numb. As we neared the exit point I received the signal to jump and did so. At the time I thought we were a bit short of the selected exit point. This later proved to be correct.

However, I jumped on signal. Exit was made without difficulty and opening was completed in approximately $2\frac{1}{2}$ seconds. After the opening shock, I checked the canopy and then turned my attention to the oscillation which was now extreme. It was at this time I saw the drift was terrific and if no countermeasures were taken there was a possibility of drifting into the Bay of Whales. I climbed about 8 feet of the forward right hand riser and shrouds in an attempt to spin the chute to the right; however, because of the greatly accelerated wind, over the expected maximum of 10 knots, this was impossible. I released the right hand riser and started spilling out on the left; this speeding my descent and moving somewhat away from the edge of the Bay ice in the event I was to drift that far. I soon saw that I was going in short of the edge of the Barrier, so prepared for landing. From the experience gained by First Sergeant S. A. London on a previous jump here, I had decided to land with feet spread about 6 inches apart. I assumed this landing position. My back was into the wind so no body turn was necessary. Upon striking the surface, which proved to be much softer than normally encountered, I attempted to roll forward, but because of the high wind was dragged across the surface before I could roll. After being dragged about 40 feet I managed to spill the chute. After spilling out I started to get out of my harness. I experienced some difficulty in releasing the snaps of the reserve as well as the snaps on the harness itself. This was caused by the fact that my hands had become very cold and numb during the time spent in the door and the descent. Because of this it required about 1 minute to remove all jump gear.

SECTION V. Recommendations

1. Clothing and Individual Equipment.

The following suggestions for equipment and clothing are recommended for use by rescue paratroopers on the Antarctic Continent, or other similar conditions which prevailed in this area at this time, both in the air and on snow and ice surface. The efficiency and comfort of parachute personnel, for rescue work, will be greatly increased. The clothing and equipment listed is believed to be adequate for an extended field operation over Antarctic surfaces:

Equipment	Per individual
Glasses, sun, with unbreakable lenses . . .	2 each
Ski, cross-country, with poles	1 pair each
Compass, lensatic	2 ea ground unit
Watch, wrist, navigator	2 ea ground unit
Knife, hunting, with sheath	1 each
Knife, Scout	1 each
Bag, musette, with harness	1 each
Bag, sleeping, Arctic, with waterproof covering	1 each
Clothing	
Trousers, woolen	1 pair
Trousers, windproof	1 pair
Shirt, woolen	1 each
Jacket, field, M1943 with hood, with liner	1 each
Parka, heavy, alpaca lined, type N-1, spec. No. Y-3267	1 each
Jacket, windproof, light	1 each
Cap, wool or fur	1 each
Drawers, wool, medium weight	2 pairs
Undershirt, wool, medium weight	2 each
Socks, wool, ski	4 pairs
Socks, cushion sole	4 pairs
Boots, ski, mountain, modified (6-inch tops)	1 pair
Mukluk, Air Corps	1 pair
Gloves, shell, trigger finger, type II, with liners, wool	3 pairs
Inner soles	4 pairs

2. Parachutes.

a. It is recommended that the *Quick Release Harness* be supplied for use by search and rescue parachutists. The importance

of this may be noted in paragraph 5*d* (13), section IV.

b. It is highly recommended that all parachute canopies, personnel or cargo, be orange in color instead of the conventional white which is so difficult to see against the solid white background of a snow surface.

c. It is recommended that the "Baseball" type cargo delivery parachute as mentioned in paragraph 4*e*, section IV, be requisitioned for use by all Army Air Force search and rescue units. This chute will carry up to a 300-pound load.

d. The use of Panatex (paint impregnated) parachute containers is not recommended in cold weather operations.

3. Aircraft Equipment.

a. The flooring around the para-exit should be of a sandpaper nature instead of the slick metal surface as found at present. The frigid temperatures tend to frost this metal thereby making uncertain footing for the jumper.

b. It is recommended that C-47 type aircraft assigned for search and rescue operations be equipped with a power-operated belt conveyor cargo discharger, which requires no discharging crew.

c. Recommend all search and rescue aircraft which would accommodate observing personnel on searching missions, i. e., C-47, C-64, be provided with observation "blisters," fitting into the windows of the fuselage. This equipment was successfully used by the search and rescue section, Alaskan Division, A. T. C., during the war. Plans and blue prints for subject "blisters" are available in Headquarters, Army Air Forces, Washington, D. C.

d. Considerable difficulty was encountered prior to take-off in breaking loose the aircraft skis, which would freeze to the snow surface. Studies and tests should be made to simplify this task. On this operation, the problem was taken care of by laying down 2-inch pieces of plywood covered over with Diesel oil on which the aircraft would taxi following a landing. Even with this precaution, it was necessary to "rev" up the engine and at the same time hit the skis with a wooden maul. A means of mechanically breaking the skis loose, from the cockpit, would be a tremendous aid.

4. Emergency Clothing and Equipment.

a. Emergency clothing and survival equipment should be packed in waterproof containers for flights over water.

b. Matches, waterproof or otherwise, as part of emergency kits should be packed in waterproof containers.

c. Cooking stoves for emergency kits, such as the stove, cooking, one burner, should be modified to use 100-octane gasoline. For normal operation this stove requires white gas. This suggested modification would enable stranded personnel to use their aircraft fuel, providing aircraft did not burn on landing.

5. Trail Flags.

Tests should be made for the manufacture of a trail flag, 12 by 14 inches, orange in color, attached to a weighted staff which can be thrown from an aircraft, landing upright with the lower portion of the flag at least 3 feet off the surface, acting as a trail marker. Where it is necessary for personnel to travel through crevassed areas it would be a relatively simple operation for an aircraft to

drop these "trail" flags, marking a safe and easier route for the ground party.

6. Pilot Training.

Rated pilots assigned to search and rescue units should undergo training in the parachuting of personnel and cargo; a superior degree of efficiency should be attained in placing cargo as close as possible to stranded personnel. Travel over snow is sometimes very difficult; to crashed personnel who may be suffering from shock, the retrieving of emergency supplies from any greater than normal distance may prove fatal. A minimum of 6 weeks' training in aerial delivery and resupply is recommended.

7. Crash Team Personnel.

Recommend the crash team include, besides medical officer and aid, at least three enlisted men familiar with aircraft and necessary tools such as tin snips, wire cutters, bolt cutters, etc., for cutting into crashed aircraft.

8. Gibson Girl Radio Equipment.

Recommend the "Kytoon" replace the "balloon" and "kite" in the Gibson Girl radio. It is further suggested that the "Kytoon" be painted with an orange metallic paint, which would render this unit visible, when aloft, for many miles and would reflect radar signals to searching aircraft.

9. Vehicles.

It is suggested that all M29 (Weasel) vehicles be fitted with a plywood protective top in lieu of the canvas cover, the plywood section to be fitted with Lucite windows. The cover should also be fitted with a trap window in the rear, large enough to pass a stretcher through and into the cab itself.

SECTION VI. Plan and S.O.P. for Army Search and Rescue Unit in the Antarctic

1. General.

a. The plan outlined below for a search and rescue unit, with its Standard Operating Procedure, is hereby submitted for study by the War Department relative to any future Army operation, similiar in scope to Operation "Highjump," in the Antarctic.

b. Search and rescue operations and the amount and type of equipment necessary for such a unit to successfully fulfill its mission depends entirely on the area of responsibility and terrain features.

c. The plan as presented below is based on a single operating base such as that operated by the Central Group of Task Force 68. A more elaborate scheme would be necessary where two or more bases were set up, elaborating on the utilization of communications and weather and rescue facilities, which would be evident with additional bases whether they were along the coast or in the interior.

d. Since Antarctic conditions present an over-all problem far exceeding the limitations of experience and knowledge gained by personnel in other theaters of operation, it is first recommended that the War Department fully utilize personnel, whether they be Army, Navy, Marine, or civilian, who have had previous experience in these southern latitudes. Such personnel should be permitted to sit in on the planning of such an operation or expedition and later be retained in such status as to exercise some degree of authority in helping to make decisions relative to varied operations in the field.

2. Primary Mission.

The primary mission of a search and rescue unit is to render emergency assistance to distressed aircraft and vessels with eventual rescue of personnel as its objective. Included in this service is distress communication procedures, distress flight control, survival methods and equipment, and the briefing of personnel in these matters.

3. Rescue Team.

It is of paramount importance that certain equipment such as aircraft, ground vehicles, crash boats, equipment to make up rescue aerial delivery kits, and selected personnel be assigned to comprise a "rescue team." This "unit" must be available for immediate operations when aircraft are "in flight" on operational missions over water, sea ice, or continental ice. The personnel should be thoroughly briefed in search and rescue operations which should include familiarity, if possible, with their area of responsibility (the farthest distance away from the base camp in any direction which can be flown safely by the longest range aircraft available).

4. Minimum Unit.

A minimum search and rescue unit is outlined below:

a. Rescue Operations Center. (1) To centralize information.

(2) To exercise emergency flight control when necessary.

(3) To direct primary rescue facilities.

(4) To coordinate secondary rescue facilities.

b. Communication Net. (1) To receive and relay distress information.

(2) To expedite and direct communications for search and rescue operations at the direction of the base rescue officer.

(3) To establish, if possible, position of unit in distress, utilizing all available communication facilities.

c. Search and Rescue Equipment. (1) Two each C-47 or C-54 aircraft, (ski-equipped) with long range tanks, with crews, equipped for towing gliders and rigged for personnel "snatch" operations.

(2) Two each Norseman aircraft, with crew, and equipped with skis.

(3) Two each L-5 aircraft, with skis.

(4) Two each glider, powered, ski-equipped, with crews and snatch equipment.

(5) Six each sets, "snatch" equipment, for personnel.

(6) Two each Weasels, with 20-inch tracks, with crews.

(7) Four each dog teams, 2 drivers each team (11 dogs per team).

(8) Two each crash boat, 42-foot with crew.

(9) Two each helicopter, with crew.

(10) Four each paratroopers.

(11) Necessary emergency survival aerial delivery kits, to include communication equipment such as "Handy-Talky" radio sets (SCR-536) to be dropped to stranded personnel from searching aircraft so as to establish immediate air-ground communication.

d. Aircraft Emergency Kits. The emergency kit listed in par. 6 *c*, sec. III, including food, clothing, first aid and emergency survival equipment, is adequate for Antarctic air operations. Emergency kits for Army Antarctic operations should be similar in content to this kit.

e. Emergency Rescue Drop Kits. (1) Emergency rescue drop kits should be prepared and available in sufficient quantity to outfit all

aircraft available for search and rescue operations.

(2) Besides those drop kits similar in content to the aircraft emergency kits (food, clothing, first aid, and implements) additional kits should be prepared, such as:

(a) Emergency crash kits (bolt cutters, wire and tin cutters, block and tackle, etc.).

(b) Emergency communication equipment (Handy-Talky radio, hand generated trail sets, etc.).

5. Training.

Prior to departing on an operation of this magnitude, all flight crews, operational as well as search and rescue, should be fully checked out in ski operations, if such gear is to be used. Through available Navy training films, they should be briefed on existing surface conditions, which vary with the seasons, as well as Antarctic environment and topography in general.

a. Paratroopers, who are indispensable to a rescue unit, whose area of responsibility includes terrain such as found in the Antarctic (mountains, glaciers, crevassed areas, etc.) should be thoroughly checked out in first aid, mountain climbing, skiing, dog driving, and any other ground rescue function necessary toward a successful rescue in this region.

b. Sledge dogs and sledging equipment should be equipped with parachutes and harness for aerial delivery, along with their drivers (which may be the trained paratroopers), to stranded personnel. The utilization of dogs and sleds in the Antarctic should not be minimized for any reasons. Crevassed areas are evident throughout these regions which would present almost impossible or even impossible obstacles for any present day ground vehicle other than dogs and their accompanying equipment.

c. The utilization of gliders and personnel "snatch" equipment is an innovation in the field of aerial rescue. Where rescue opera-

tions are necessary and rescue aircraft cannot safely land to evacuate stranded personnel, because of soft snow surfaces, crevassed areas, etc., it may be possible to set a glider down for this same purpose. As a last resort, personnel "snatch" equipment could be utilized, where other means are not practicable.

d. *Crash boat* and crews should "stand by" in open water alongside the ice, engine running, during aircraft take-offs and landings. Following a take-off, boat and crew may secure only after aircraft is airborne and out of sight. Boat crews report back on duty 15 minutes prior to the return of an aircraft and secure only after aircraft has landed. It is assumed that air bases will be in close proximity to the edge of the ice and open water.

e. *Helicopters* will be utilized in search and rescue operations at the discretion of the base rescue officer.

f. *Paratroopers* should act as aerial observers, equally divided among searching aircraft, so that this service can be immediately utilized if necessary, upon locating survivors by searching aircraft.

6. Responsibilities of Personnel.

The responsibilities of search and rescue unit personnel are defined as follows (fig. 165):

a. *Aircraft Maintenance Officer*. To provide maintenance to search and rescue aircraft as necessary, so that such designated aircraft will be available at all times for immediate emergency operations.

b. *Supply Officer*. To make available, at all times, equipment necessary for the successful completion of emergency flight, ground or sea operations.

c. *Communication Officer*. (1) To place all available communication facilities at the disposal of the base rescue officer during emergency operations. To guard emergency frequencies from the time of take-off until

return of each flight, local or otherwise. To report immediately to the base rescue officer and the flight operations officer failure to make contact with any flight at scheduled radio contact periods.

(2) The rescue communications net, which will function in receiving and disseminating distress information, will be the responsibility of the communication officer.

d. *Personal Equipment Officer*. To provide, through regular supply channels, emergency (standard and nonstandard) equipment for all aircraft, operational and those designated for search and rescue operations. To check aircraft emergency equipment for breakage, spoilage, or missing equipment prior to each flight and immediately following the return of each flight. Aircraft should not be cleared for flight, local or otherwise, by the flight operations officer until clearance is concurred in by the personal equipment officer. The personal equipment officer will be responsible for the briefing of aircrews and passengers on utilization of emergency equipment and will work in close coordination with the base rescue officer, especially in regard to emergency survival kits rigged for aerial delivery.

Note. It is suggested that all operational flight crews, as well as search and rescue crews, be familiar with the search and rescue plan and search and rescue equipment, so that these crews may be called on for immediate aid whenever necessary.

e. *Base Rescue Officer*. Will be responsible for all air, ground, and sea equipment designated as search and rescue equipment. He will see that all such equipment is available for immediate emergency operations at all times. He will also be responsible for the training of all designated rescue personnel in search and rescue procedures and operations. The base rescue officer should, prior to each operational flight, familiarize himself with the flight plan as filed with the flight operations officer. He should direct and control

search and rescue operations and be authorized to call on any available personnel and/or equipment to aid in fulfilling his mission. The base rescue officer will be responsible to the flight operations officer, but in case of emergency operations, will be authorized to communicate direct with any higher authority or any other office or officer so that his mission may be completed with the least loss of time. The base rescue officer should also be responsible to see that adequate emergency sustenance and survival aerial delivery kits are aboard search and rescue aircraft at all times, ready for immediate use. A "ground rescue officer" will be selected and appointed by the base rescue officer to aid in carrying out search and rescue responsibilities. The ground rescue officer, through the base rescue officer, will be responsible for

all ground and sea search and rescue equipment as well as personnel assigned to these units.

7. Search Operations.

a. When a distress report is received, or scheduled radio contacts between base and aircraft have not been accomplished, or an aircraft is assumed to be in distress for any reason, the base rescue officer will first obtain all available information on the situation, so that he may properly plan a course of action. If search is necessary, the following minimum factors will influence his planning:

(1) Best known or most probable location of incident. This can best be determined from last radio contact and knowledge of the flight plan.

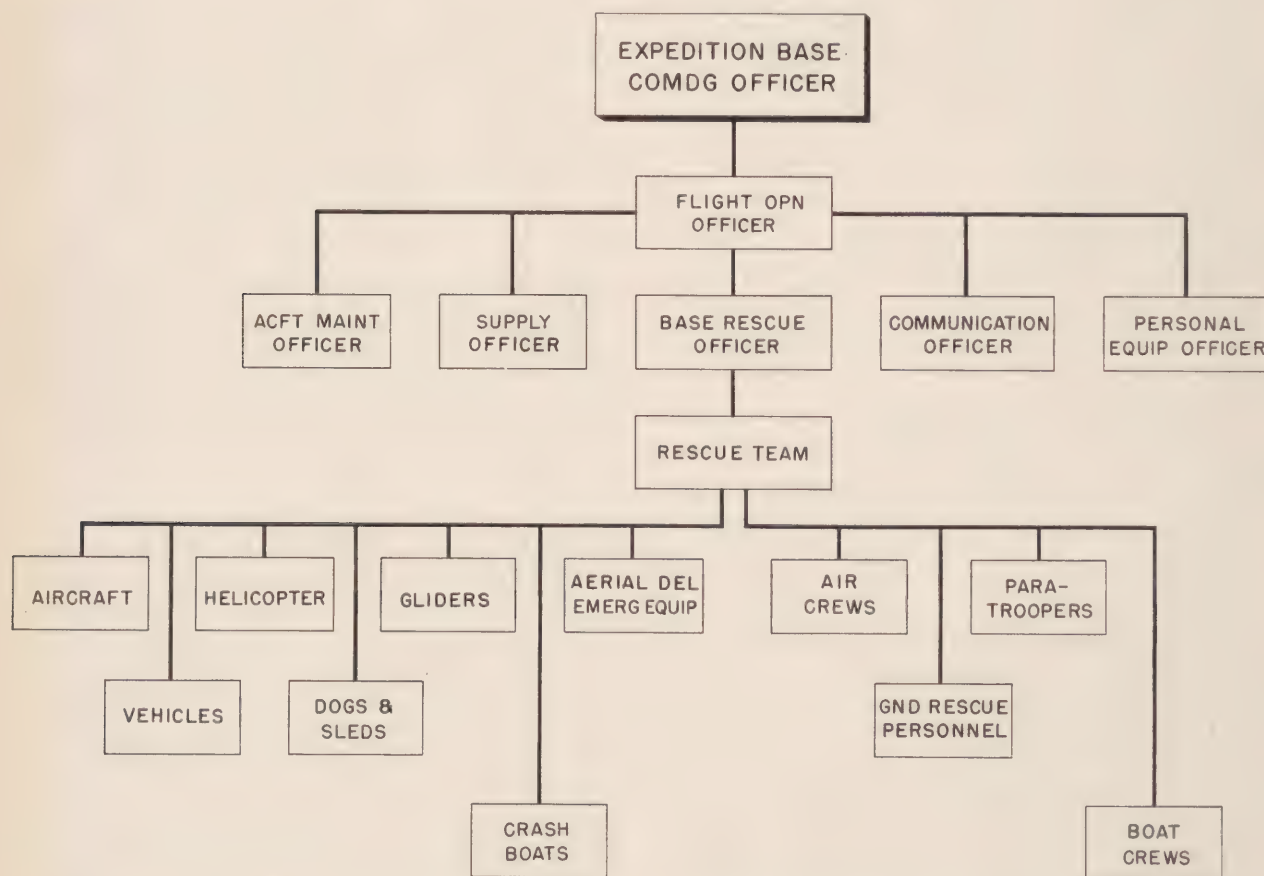


Figure 165. Organization of search and rescue unit.

(2) Local weather conditions as given in the last radio contact by missing aircraft and weather forecast as shown in the flight plan.

(3) Whether personnel in distressed aircraft parachuted from aircraft, made a forced landing, ditched, etc.

(4) If aircraft ditched, determine, if possible, force and direction of ocean current.

(5) Survival and sustenance equipment aboard (check with personal equipment officer) and number of personnel aboard aircraft.

b. If it is decided that aircraft landings in close proximity to the location of the stranded personnel are not feasible and other means of rescue will be necessary, the situation will be carefully studied as to which available means of rescue will be the fastest and safest for all concerned. (However, great the problem, it is the opinion of this observer that rescue in the Antarctic can be successfully effected provided adequate equipment and competent personnel are available.) The problem may present a comparatively simple operation utilizing gliders. Small aircraft such as the C-64 (Norseman) or L-5 type aircraft may find it possible to land and evacuate survivors where the larger and heavier type aircraft cannot do so. It may be that helicopters can be used or that it is necessary to utilize the ground units. Perhaps a joint operation of all afore-mentioned units will be necessary. Time is the greatest factor in accomplishing a successful rescue mission. Such an operation usually requires weather conditions at their best. If possible, where ground rescue units are employed, leaders of these units should be flown over their projected routes so that they may study, from the air, existing ground conditions and the terrain they will have to traverse with their equipment, whether it be with vehicles or dogs. This may also be accomplished by a study of photographs of the route.

c. The base rescue officer should, in all cases, assume direct control over rescue proceedings and in conjunction with this, study all problems with special regard to speed and safety in evacuating the distressed personnel. A successful rescue in the Antarctic might easily entail ground and air support in laying down fuel caches for use of smaller aircraft or helicopters whose operating range is limited.

d. In general, missing aircraft can be considered to be down on a track between two points. These points may be the point of departure (terminal station) and point of destination, or the point of last reported position and destination. This does not include incidents in which distress messages have been received giving full details as to position of incident, etc. In the case of most operational flights, the points of departure and destination will be the same, namely the airstrip at the base camp. However, for all practicable purposes, it can be assumed that the point of destination will be the farthest distance away from the airstrip prior to the return of the aircraft to the base camp in accordance with the flight route as filed in the flight plan.

e. Since the length of the flight track will usually be extensive, the most feasible manner of conducting the initial search flight is for two aircraft (C-47) to search on parallel courses, one on each side of the course of the missing aircraft and each separated from this course by the limit of visibility. Searching altitudes will, in all cases, be determined by the pilots in accordance with terrain, visibility, and weather conditions en route. Upon reaching the "destination" of the missing aircraft, and provided nothing has been seen, each of the searching aircraft will return to the base camp along parallel routes on their particular side of the course of the missing aircraft, except that the return flight will be made at a distance twice the limit of visibility of the course of the missing aircraft.

[illegible]

Figure 167. Square search.

shortest period of time. It is suggested that areas square in nature be assigned searching aircraft, these areas, designated by latitude and longitude, to be chosen in light of the last position report of the missing aircraft, heading of the aircraft, weather conditions, etc. Areas will usually be adjacent to and on each side of the flight route. It is suggested that the "parallel" or "square" search patterns be used, as shown in figures 166 and 167. As in the initial search operation along the flight route, continuous photographs should be made from each side of each of the search aircraft. Upon return of the search aircraft, each searching crew member and observer will be interrogated by the base rescue officer on the operation of the flight. Particular note should be given by flight crews to noting any portion of the ground not seen due to overcast, etc. This area, even though very small in size, should be plotted so that it may be investigated on a later flight, keeping in mind that a "lost" aircraft can be down anywhere within the radius of its fuel supply.

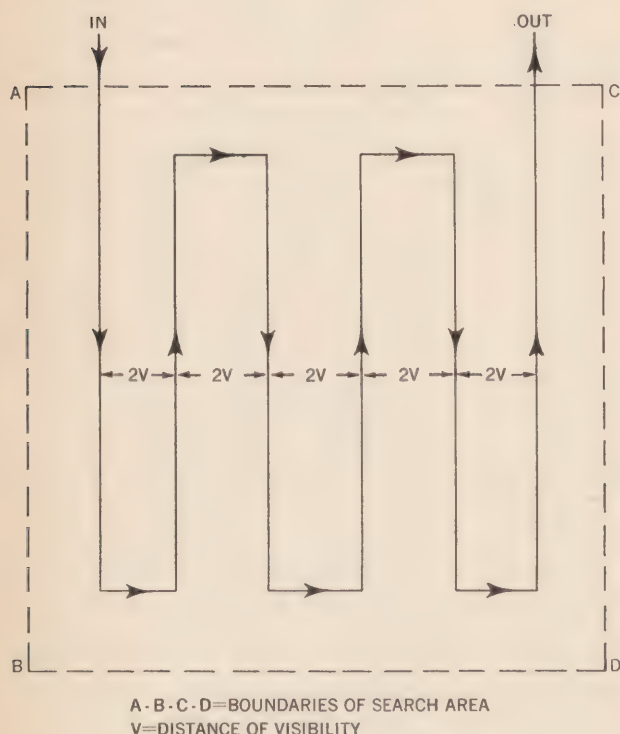


Figure 166. Parallel search.

h. Upon sighting survivors on continental ice, search aircraft will immediately drop to survivors a "Handy-Talky" radio set so as to establish immediate air-ground radio communication. At this same time definite "fixes" will be made of the location of the survivors and transmitted immediately to the base camp and other searching aircraft in the vicinity. Sustenance and survival equipment will then be dropped. If, after radio communications have been established, it is found that medical or other personnel aid is necessary, the pilots of the searching aircraft will study the situation as to feasibility of landing their own aircraft for evacuation and rescue of the distressed personnel. Prior to any landings of this nature, a report of conditions and the situation will first be made to the base camp and approval granted by the base rescue officer. If landings are not possible in the immediate vicinity of the distressed personnel, then the services of the paratroopers will be utilized at the discretion of pilot of the searching aircraft.

i. If in rescue operations it is necessary to

utilize any or all of the ground units, it is suggested that the ground units be given full and complete air support and coverage. Where ground units may have to pass through dangerous terrain, such as that covered over by crevass areas, aircraft may spot these areas and by means of air-ground communication "pick" the route best suited to the ground party. If possible, ground units will be transported by air to the safest landing area nearest the distressed personnel. Ground vehicles such as the M29 (Weasel) will not fit into a C-47. However, the air transport of dogs, sleds, and trail equipment in this aircraft is a safe and suggested operation. Ground units, when on the trail, should make at least one radio contact with the base camp each day, reporting their position and local weather conditions, etc. If weather permits, aircraft will fly over and make contact with both the distressed personnel and the ground rescue party at least once a day. This air support must continue until all personnel have returned to the base camp.

MEDICAL*

SECTION I. Plans, Objectives, and Policies

1. Medical Section.

The staff medical section of Task Force 68 (Operation Highjump) was located on the Flagship, the U. S. S. *Mount Olympus*. This section consisted of the Surgeon, Commander H. B. Eisberg (MC), U. S. N.; Assistant Surgeon, Lt. (jg) H. H. Richardson (MC), U. S. N. R., and two hospital corpsmen. The Assistant Surgeon and one of the corpsmen were to set up and operate the base camp dispensary. The dental section consisted of one officer, Lt. Owens (DC), U. S. N., who was to operate the base camp dispensary. The U. S. S. *Mount Olympus* had

its regular medical complement. The medical sections of the three groups of the task force were set up to operate independently of each other but under the supervision of the Task Force Surgeon who was with the Central Group. Frequent radio contacts were made regarding over-all medical policies and plans.

2. Medical Plan.

Prior to departure of the task force, the following medical plan was drawn up and distributed to all concerned as an annex to Task Force 68 Operation Plan No. 2-46:

a. Medical Personnel, Supplies, Equipment, and Facilities.**

	Medical off.	Dental off.	Hosp. corps	Sick berths	X-ray units	Oper. rooms	Commissioning allowances
Staff.....	2	1	3	.....	.....	.....	.....
Central group:							
U. S. S. Mt. Olympus.....	1	1	5	17	1	1	1,000 man.
U. S. C. G. C. Northwind.....	1	0	1	4	1	1	300 man.
U. S. S. Sennet.....	0	0	1	0	0	0	Special sub.
U. S. S. Burton Island.....	1	0	1	4	1	1	300 man.
U. S. S. Yancey.....	1	0	1	8	0	0	600 man.
U. S. S. Merrick.....	1	0	3	8	0	0	600 man.
Eastern Group:							
U. S. S. Pine Island.....	1	1	8	21	1	1	1,000 man.
U. S. S. Brownson.....	1	0	2	0	0	0	Special DD.
U. S. S. Canisteo.....	1	0	2	6	0	0	300 man.
Western Group:							
U. S. S. Currituck.....	1	1	8	21	1	1	1,000 man.
U. S. S. Henderson.....	0	0	2	0	0	0	Special DD.
U. S. S. Cacapon.....	1	0	2	6	0	0	200 man.
Base camp.....	1	1	2	0	0	0	Special field.
	(Staff)	(Staff)	(Staff)				

*The Army Observers Medical Section was divided into two parts. Aeromedical and related subjects were the primary interest of Lt. Col. Robert C. Love, AAF Medical Observer. The general medical aspects of the operation were assigned to Major Dan Crozier, observer from The Surgeon General's Office.

**There are sufficient medical supplies available to the Task Force for 12 months. Each unit of the Task Force has been equipped to operate independently during the operation.

b. Sanitation. (1) The general provisions concerning sanitation as outlined in the Manual of the Medical Department, chapter 5 (a), will be carried out.

(2) Sea water will not be used in the preparation of food. All salt water connections to galley spaces will be closed off.

c. Quarantine Procedures. (1) When leaving from a United States port or a foreign port, the ships of the Task Force will procure a Bill of Health from the proper authorities of that port (usually the U. S. Public Health Service Quarantine Officer.) When sailing from a foreign port, a United States Bill of Health must be obtained from a United State Consular officer.

(2) The Manual of the Medical Department, chapter 501, Quarantine Procedures, and NavMed 126, Manual of Naval Hygiene, chapter XXIV, will be consulted for further information.

d. Evacuation and Treatment of the Sick and Injured. (1) On vessels without medical officers, the senior pharmacist's mate aboard will immediately notify the Commanding Officer in the event that the condition of a patient necessitates consultation with a medical officer. A medical officer will be available in each of the task groups. Any ship on a temporarily isolated station will either rejoin the nearest task group, or, weather permitting, evacuation by air will be carried out.

(2) Evacuation to the United States will not be possible.

(3) The Commander Task Force Sixty-Eight will be notified immediately of cases placed on the critical or seriously ill lists, and in cases of death.

e. Reports and Communications. Copies of all reports and communications required by the Bureau of Medicine and Surgery, Fleet Medical Officers, and Hospital Corps Personnel Sections of the Atlantic and Pacific Fleets, shall be sent to the Staff Medical Officer.

f. Medical Problems Relevant to the Operation.

(1) *Operations in Latitude 40° N. to 40° S.*

(a) Every attempt must be made to prevent venereal disease occurring while personnel are ashore on liberty on the outward, as well as the homeward bound voyage.

(b) Heat cramps, heat exhaustion, and heat stroke should not occur unless personnel fail to heed the directives of the medical department of each ship concerning the use of salt, fluid intake, over-exposure to sun, or excessively warm spaces.

(c) Lookouts should be equipped with sun glasses on bright days to prevent the harmful effect of solar radiation, particularly that of glare actinic conjunctivitis.

(2) *Operations at Sea in Latitudes 40° S. to the Antarctic.* (a) The ships of the Task Force will face a gradual increase in wind velocity and a decrease in temperature leading to what is considered to be some of the worst weather in the world. A reference to the meteorological annex will give an accurate picture of what to expect.

(b) Eyes of lookouts will have to be protected from the extreme winds. The present N-2 Navy Goggles are adequate, though fogging of the lenses is a constant source of annoyance.

(c) The skin of topside personnel will have to be protected. Chapping, windburn, and Herpes Labialis will occur in a certain percentage of personnel despite all precautions. Frostbite of the face and of the extremities may be prevented only if properly indoctrinated personnel use the clothing supplies in the correct manner. At times it may be necessary to furnish relief for exposed watch-standers in order that they may warm themselves. Watches as short as 1 hour may be necessary. Lookouts on the submarine during "Nanook" were relieved every 30 minutes during certain phases of the operation.

(d) A loss of general over-all efficiency of

topside personnel must be expected due to the effect of the wind and temperature.

(e) Damage to the respiratory system may occur following continued and prolonged exposure to the low humidity aboard ship resulting from the use of the present heating systems. Maximum ventilation must be maintained at all times.

(f) Insufficiency of drying and storage facilities for clothing will exist due to the increased issue of clothing and the inclement weather.

(g) Inadequate provisions for the protection of personnel forced to abandon ship must be realized and all possible precautions and preventive measures taken.

(h) Temporary injury and possible death from immersion and exposure in water demands smart and effective rescue procedures for a man overboard.

(3) *Antarctica, Including the Off-Lying Islands South of Latitude 60° S.* The following publication is recommended for information: "Sailing Directions for Antarctica, 1943, H. O. No. 138, Including the Off-Lying Islands South of Latitude 60°", pages 41-52 entitled "Health and Living Conditions." The following is quoted from that publication:

General . . . In spite of its rigors, the climate of Antarctica has been reported to be extremely healthful; respiratory disease, for instance, is especially rare. Insect pests are unknown . . . adequate food, shelter, and equipment for transportation ashore must be provided in advance. The personnel must possess the degree of health, stamina, competence, and resourcefulness required in the most exacting of peacetime assignments.

(4) *Physical Requirements, Diet, Clothing, Etc.*

(a) *Physical Requirements.* The present naval standards governing physical fitness for over-sea duty are considered adequate in the selection of personnel for duty in Antarctica.

(b) *Diet.* The standard Navy ration will be increased 25 percent during the period of the operation. This diet is expected to be adequate for all personnel provided that

the ration is properly prepared, and that sufficient portions of each component are eaten. The need for supplementary vitamin preparations is not anticipated. The medical department of each ship and each shore activity has a responsibility to make certain that personnel are aware of the value of intelligent preparation and intelligent eating habits. Recommendations should be made immediately, to the commanding officer in the event that food discipline is relaxed.

(c) *Clothing.* It is expected that the clothing provided will be adequate to protect personnel during the period of the operation. Adequacy does not imply perfection, and members of the medical departments should be able to contribute suggestions for improvements. Clothing ashore will be based on the over-dress principle for personnel on vehicles, standing still, and doing light work, and the under-dress principle for dog-sled drivers, ski-parties, etc.

(d) All of the medical problems that may arise at sea in latitudes from 40° South to the Antarctic will be present to an increased degree. In addition the reflection from snow and ice will increase the potential damage due to solar radiation, and the possibility of carbon monoxide poisoning in tents must be guarded against by all personnel.

(e) The success of this operation will depend on the proper indoctrination of normal individuals. Survival in the polar regions is a question of individual adaptation. Protective measures for the group will not suffice to save a stupid or poorly indoctrinated individual.

3. Directives.

In addition to the medical plan certain staff directives were issued to supplement the plan and furnish more detailed guidance.

a. Physical examinations were directed for all personnel. These examinations took the general form of an annual physical (now

required by the Navy for enlisted men as well as officers) and included a routine roentgenologic examination of the chest.

b. Immunizations prescribed were: typhoid booster, tetanus booster, and smallpox.

c. A directive was issued requiring that all personnel using spectacles be provided with two pairs, one of which had to be the service issue, steel-rimmed, type.

d. All shore parties landed from task force vessels were to obtain and carry first aid equipment. It was recommended by the Staff Medical Officer that the life raft emergency kit be used for this purpose.

e. All small boat first aid kits were required to be checked once a month and a log kept to indicate compliance with the directive and the condition of the equipment inspected. This precaution was taken for much the same reasons as the AAF requires periodic checks of aircraft first aid kits.

f. Each ship having a medical officer was required to have at least 4,000 units of insulin available for treatment of a possible coma of diabetic origin. (Insulin is not included in commissioning allowance up to and including 1,000 men.)

g. The submission of a Special Sanitary Report by all ships at the completion of the project was required, and the form prescribed was that of the Navy Annual Sanitary Report. The outline below is a brief of this report as prescribed in the Manual of the Medical Department, U. S. N., part 3, chapter 5, paragraph 12:

Annual Sanitary Report, U. S. N.

A. Basic Data.

1. Ship: Type, size, etc.
2. Berthing: Decks used, men per deck, cubic footage per man, etc.
3. Heating, ventilating, and air conditioning.
4. Toilet and bathing facilities.
5. Prison cells.

6. Barber shop.

7. Lighting.

B. Other Data on Ship and Its Personnel.

1. Movements of ship during period of report.
2. Average strength of ship's complement, officers and enlisted men.

C. Immunization Data.

1. Statistics on all immunizations done.
2. Epidemiological situations encountered.

D. Data on Food and Water.

1. Drinking water.
2. Food storage, galleys, and messing facilities.
3. Rations.

E. Medical Department Facilities and Personnel.

1. Physical plant.
2. Supplies.
3. Hospital Corps: Adequacy, proficiency, etc.
4. Battle stations: Plans for care of wounded, etc.

F. Clothing.

G. Miscellaneous.

1. Mechanical hazards.
2. Industrial health exposures.
3. Disabling injuries.

H. Recommendations.

I. Historical Data.

h. Each ship and shore based unit was directed to take all action possible for protection of personnel in general accordance with the section on protection of personnel in "Instructions for Cold Weather Operations of Naval Aircraft," pages 43, 44, and 45, Technical Note No. 84-45, AER-E-45-JED, F24-5 (1), as follows:

(1) *General.* Personnel undertaking cold weather flight operations should exercise great care in preparing themselves for flight, ground activities, or work in exposed positions ashore or aboard ship. Failure to do this can result in great physical discomfort or serious injury. Upon arrival at a base or reporting aboard a ship from which you will operate,

one of the first calls should be upon the supply officer to obtain the proper clothing and equipment. Aircraft carriers should have the proper equipment readily available for issue to flight deck or to other exposed personnel.

In extremely low temperatures it is impracticable to carry sufficient equipment in carrier aircraft, either in life rafts or the emergency parachute packs, to sustain life indefinitely in case of a forced landing at sea. This emphasizes the need for constant diligence on the part of all personnel concerned to avoid water landings if possible. Rescue of personnel in the water must be effected within a few minutes under the worst conditions and in any event within a few hours to prevent serious injury from exposure.

The following general precautions apply to all personnel, ashore or aboard ship, during very cold weather.

(a) Perspiration is dangerous in sub-zero temperatures. If the feet or other parts of the body perspire make certain that the clothing and the body are dry before exposure to severe cold. Ice will form in damp clothing and damp portions of the body will freeze quickly.

(b) Suitable and adequate clothing must be worn at all times. Clean dry woollens should be worn next to the body. Shoes should be loose fitting and allow for one or two pairs of wool socks. Gloves, and if necessary, a face mask, and goggles should be worn in extremely cold temperatures. A parka, or a helmet with protection for the head and ears is essential for working or watch standing. Above all, avoid tight fitting clothes which impair the circulation and wet clothes which may freeze.

(c) In temperatures as low as -32°C . (-25°F .) there is danger of freezing the lungs from overexertion followed by deep breathing. If you inadvertently overexert and start breathing heavily put your head down and breathe warm air from inside your clothing until the deep breathing stops.

(d) Light shelters or heated nose hangars should be used around aircraft ashore for maintenance crews to work efficiently. Most maintenance work aboard carriers must be done on the hangar deck.

(e) Do not touch any metal parts of the airplane or any exposed metal without gloves. The moisture on the hands may freeze to the metal surface and result in painful tearing of the flesh. Metal tools may be insulated by wrapping the handles with tape or light line.

(f) Gasoline spilled on the hands or clothing in sub-zero weather will freeze flesh a few seconds after contact. This should be watched particularly when making the check for water in the gasoline.

(g) In flights over land, where the combat loading permits, emergency equipment for each crew member should be carried as follows:

Sleeping bag.

Emergency rations, matches, and candles.

Emergency clothing, such as parka, footgear, woolen underwear, and socks.

Emergency kit with gun, ammunition, fishing gear, fire building materials, ax, etc.

(h) In the event of forced landing do not bail out unless it is absolutely necessary; and—

1. *On Land*. Remain in the vicinity of the airplane to conserve energy, to avoid exertion, and to simplify rescue. Do not travel unless you have adequate equipment, Arctic experience, and then only when you are positive of your position and know that shelter and assistance are near, or you know that searchers probably cannot reach you. If you bail out, keep your eye on the airplane and try to get back to it. Save your parachute.

2. *At Sea*. After exposure to sub-zero water death is "just around the corner." The quick donning exposure suit described in Technical Note 7-45 or the constant wear exposure suit will help greatly to sustain life until rescue can be effected. Every possible effort should be made by all hands to prevent forced landings at sea in cold weather. In any event, if temperatures are not too low you may survive for several days, even without food, if you relax, get plenty of sleep, avoid exhaustion, avoid panic, and conserve your energy.

(i) Exposure to low temperatures, especially in a strong wind, carries risk of frostbite, the parts most susceptible to this being the cheeks, nose, ears, chin, forehead, wrists, hands, or feet. Frostbitten skin becomes whitish and stiff and the parts feel numb rather than painful. Personnel working in exposed positions should frequently return to a warm area or shelter to prevent frostbite.

(j) Snow-blindness caused by glare of the snow is a common Arctic affliction and may occur not only on bright days but on days of fog or overcast. Colored goggles or sun glasses are as important for protection of the eyes in cold weather as in the tropics, particularly if assigned to a shore station.

(k) If the nature of work about an airplane precludes the use of heavy gloves, light ones should be worn if at all possible. This is necessary to prevent freezing to metals, to prevent frostbite, and to prevent cuts or nicks to the skin or flesh going unnoticed because of numb hands.

(l) Frequent rest periods in heated enclosures with hot coffee and sandwiches are necessary for the greatest efficiency of personnel working in exposed positions.

(2) *Clothing and Equipment*. (a) *Flight Gear*. Flight gear should be light and flexible in addition to providing sufficient warmth to enable the combat flight crews efficiently to accomplish their missions in cold weather. The clothes must also be designed to facilitate cooling when overheated. In case of extreme overheating the clothing may be opened down to the underclothing to eliminate moisture. The correct body temperature can best be maintained by means of the electrically heated flying suits being provided. These are recommended for use in preference to the shearling. The two types are described below:

1. *Unheated*. Consists of shearling jacket and trousers, shearling boots, shearling helmet, and lambskin-lined gloves. This outfit will protect the wearer indefinitely at -12°C . (10°F .), for prolonged

periods up to the duration of any flight at -18° C. (0° F.), for 6 hours at -23° C. (-10° F.), and for 3 hours at -29° C. (-20° F.). This outfit is heavy and bulky and cannot be worn in the cockpit of some airplanes because of space restrictions.

2. *Heated.* Consists of a one-piece suit, boots, and gloves wired to take current from 24-volt airplane circuit. Electric heat is not supplied to the helmet and standard winter shearling helmets are worn. This outfit will protect the wearer down to -29° C. (-20° F.) and at lower temperatures for shorter periods. Newer suits will include increased insulation and will protect at even lower temperatures. Provision is made for attaching electrically heated oxygen and face masks and heated goggles. This type clothing is much lighter in weight than shearling.

All items of flight gear together with recommended allowances are listed in appendix 4.

(b) *Clothing and Equipment for Ground Personnel.* All items of cold weather clothing available from naval sources are listed in appendix 4, together with recommended allowances for aircraft carriers, air groups, and shore based aviation personnel. Additional details, including allowances for other types of vessels and instructions for requisitioning these items are included in CNO letter OP-50-A, Serial 22950-A of 21 December 1944, and in article 1149-0 BuSandA memo.

The detailed descriptions and uses of these articles are beyond the scope of this Technical Note.

Where Army supply sources are accessible articles of cold weather clothing and equipment are often available for emergency issue to naval activities.

(3) *Personal Care and Health.* Most of the precautions necessary to prevent injury and to maintain personal health and comfort during cold weather operations have been covered in previous parts of this manual. It will suffice to add here that health, comfort, and morale can be maintained at a normal high level provided all hands are forewarned as to the hazards and difficulties peculiar to low temperatures and take the necessary precautions to prevent their occurrence. It is only necessary to remain constantly alert, take the necessary precautions, and wear at all times adequate and proper clothes for the type of weather or conditions encountered.

It is beyond the scope of this note to cover all possible contingencies or emergencies which may occur during cold weather operations. Other publications which cover personal problems in more detail are—

(a) Instructions for Arctic Operations, Army T. O. No. 00-60B-1, dated 1 November 1944, or subsequent revisions thereto.

(b) Arctic Sense, NAVAER 00-80-Q-13, issued by the Aviation Training Division, Office of CNO.

(c) Aleutian Sense, issued also by the Aviation Training Division, Office of CNO.

The above contain certain valuable information and should be read by all hands who expect to engage in any part of aircraft cold weather operations. These pamphlets have been previously distributed to the fleet and additional copies are being made available to ComAirPac.

i. A standard therapy of cold exposure cases was prescribed. The methods to be used were those set forth in the Air Sea Rescue Bulletin for April 1946, an extract of which follows:

Rapid rewarming of chilled survivors has long been considered dangerous. It now is believed, however, that in view of the results of the experience incident to World War II and the comments on them by outstanding American authorities, the treatment of survivors after exposure to low temperatures may be formulated as follows:

If *unconscious*, but breathing (this situation is likely to occur if rectal temperature is below 80.6° F.) the individual rescued from cold water should be immediately undressed and placed in a bath from 115° to 120° F. for 10 minutes, then dried with a towel and placed in warm blankets. If the temperature does not rise at a rate of at least 2° F. every 10 minutes thereafter, immersion in warm water should be repeated until the rectal temperature reaches 93° F. There is considerable rise in temperature after removal from the warm water, and there is no advantage to be gained from rapid heating once this safe level has been regained. If a warm bath is not available, warm water should be poured into the sleeves, trouser legs and over the clothing and body, or the survivor should be carefully held under a warm shower. In any event, no time should be lost in applying treatment after rescue.

If *conscious*, the survivor should be immersed in water from 105° to 110° F. for 10 minutes, after which time treatment may be carried out as for the unconscious person. Water heated to 115° F. is painful to a conscious patient and may cause some scalding in chilled persons with rectal temperatures above 91° or 92° F. It appears likely that survivors who are conscious when rescued from cold water will often survive without the aid of the warm bath if they are merely dried and placed in light cradles or electric heating bags.

Survivors exposed to moderately cold temperatures for long periods should be rewarmed much more slowly, preferably by the use of heated blankets, electric heating bags, or light cradles.

Survivors exposed to dangerously low temperatures for long periods should be rapidly rewarmed, preferably by a warm bath, until the rectal temperature begins to rise. More gradual rewarming is indicated as soon as the immediate danger from extremely low temperature has passed.

Massaging is to be avoided under all circumstances. Drugs, such as strophanthin, digitalis, metrazol, lobeline, coramine, and alcohol are of no value. In fact the results of experiences considered reliable show them to be harmful.

Administration of 100 percent oxygen at atmospheric pressure should be advantageous by supplying dissolved oxygen not dependent upon hemoglobin dissociation.

... the temperature should be taken immediately after rescue while the warm bath is being prepared.

It is also urgently recommended that the temperature of the sea water at the site of rescue shall be determined and recorded in the survivor report.

To this therapy the Staff Medical Officer added, "Conscious survivors shall be given warm, nourishing drinks. Plasma will be given if survivors are unable to obtain adequate fluid by mouth."

j. A member of the medical department was required to be in attendance during flight operations in case of emergencies. First aid equipment to be carried on the boat acting as plane guard was prescribed.

4. Evacuation Policies.

a. During the voyage the various ships' surgeons were authorized to retain and treat any type of case or to evacuate major diagnostic or surgical problems to the flagship at their discretion.

b. While operating in the Bay of Whales area all patients of the ice party requiring bed rest or surgical treatment were to be evacuated to the ships in the bay.

c. While no ships were in the bay, shore-based facilities were to be used entirely, there being no possibility of evacuating to any ship by air.

5. Safety.

On 15 January 1947, Staff Memorandum No. 2-47, subject, "Safety Precautions, Rules in Observing When on Ice," was published for the information and guidance of all hands. It contained many points having medical implications, as follows:

There are many rules and safety precautions which *must* be observed and followed by all personnel of Task Force Sixty-Eight while on the ice in the Antarctic regions.

a. *Travel.* Remain in the immediate vicinity of the ship or camp unless in company with other members of the party, and be equipped with safety line and sufficient wearing apparel. Always walk in single file, lead man to test surface. Stay on the marked trail or known area unless proper sounding and tests are made to determine the condi-

tion of the surface. Do not take the risk of falling into an unmarked crevasse. Stay away from the edges of the shelf and bay ice; if you slip or the edge breaks off and you fall into the water you will probably die before help can reach you. If a sudden blizzard catches you out of sight of the camp do not wander aimlessly about; stay where you are and dig in for shelter. You will be safer and more easily found. Molesting or chasing seals or penguins will not be tolerated. An inexperienced person would get a bad bite. If it is necessary to kill seals for dog food or collect specimens of any kind it will be done by authorized personnel. Do not eat snow. If necessary snow may be eaten only after melting it in the hand.

b. *General.* Keep a watch for frostbitten skin on other men in the group; skin when frozen is milk white. Do not rub snow on the frostbitten part, instead place a warm hand over the frozen area or put the frostbitten hand or foot against the warm skin of yourself or another to thaw it out. Use chapstick or face grease on the lips. Chapped lips and cold sores are painful. Carry chapsticks in your pocket. Drifting snow will soon cover any article of equipment, clothing, or tools left on the surface of the ice unmarked. Mark the location with trail markers or other suitable upright stakes. Never remove any marker other than your own; it is placed there for some definite purpose. Skis and poles should not be left lying down when removed from the feet. Stick the skis into the snow in an upright position, pass the hand loops of the pole over the points of the skis, and stand them upright alongside. Don't set up a cache or place any object in such a position that the drift formed by such an object will cover other articles of equipment. When cooking in a tent be sure you have plenty of ventilation for escape of fumes given off from cooking stoves. Remove snow from clothing with a whisk

broom or other suitable brush before entering tent or other warm shelter; otherwise snow will melt and garments will become wet. Try to remain active when outside shelter, don't stand around idle. A large area of snow upwind from the snow melter will be staked off and all personnel not engaged in obtaining snow to melt will stay clear of this area at all times, as drinking water will be obtained from this area of snow. Heads will be provided in the camp area and must be used except that urination is allowed just off the beaten tracks and trails. Carry a supply of toilet paper in your pocket at all times in case an emergency arises!

c. Boating. Use caution when approaching ice of any type. Coxswain and engineer shall not leave tiller or engine unattended. When approaching the ice, be alert and in full control of the boat. The ice gives no warning when breaking away. Crews must be in readiness to make rapid change of movement. Do not jump or leave the boat until satisfied with conditions of the ice approached. When making a landing and the ice is higher than the boat, proceed with caution, slow speed head on. Keep engine slow ahead while nosed into ice. Rig ladder, while making approach, using bow and stern hook to hold ladder in place. Get personnel and equipment on or off the ice as rapidly as possible and back away. When running close to ice, have bow hook watch for partially submerged ice chunks or ice foot. Ice foot is usually found protruding from larger pieces of ice and submerged. Ice foot is solid, sharp, and can easily tear a hole in a boat. Engines will run colder in the Antarctic; watch circulation; use as little water as possible by cutting down suction. Drain engine block immediately whenever boat is hauled out. Do not allow water to remain in engine circulation system. Bypass glass-covered strainers if possible. Check fuel, oil, and

boat equipment each time relieved or boat is hauled out. Before leaving the boat top off fuel tanks and have boat ready for instant use. Have all fire equipment in readiness. Use standing Navy fire regulations for ship's boats. Keep bilges clean and check bilge pumps frequently.

d. Mechanized Equipment. If preheating of engines is necessary, be careful not to play the flame of heating torches direct onto cast iron parts in concentrated areas. This is particularly true of cast iron crankcases which may be easily cracked from concentrated heat application. Keep the fuel tanks as nearly full as possible at all times by refueling frequently in order to cut down condensation in the tanks. Ice in the fuel lines is a great hazard. Disassembly of the lines must be accomplished with the bare hands, and fuel spilled on the bare flesh is conducive to extremely severe frostbite. Barrels of fuel must never be pumped completely dry. To do so increases the chances of picking up water caused by condensation, which will lie on the bottom. It may be necessary to modify the fueling pumps in order that 2 or 3 gallons will remain in the bottom. It is very important, and a "must", that all fuel be filtered if at all practicable. Before opening a barrel of fuel, make certain that the snow is kept absolutely clear of the openings. In the case of the Cargo Carrier M29C (Weasel) caution must be exercised in starting the machine in motion too quickly after it has sat for a long period. The track bands of these machines are particularly vulnerable since they are of a steel-cable-rubberized-fabric construction. It may be necessary to roll the machine forward and back a few times to loosen up the stiff track bands. This vehicle may prove to be one of our most valuable, therefore, great care must be exercised in its proper operation.

e. Emergency Signal. The continuous blowing of repeated blasts on the ship's whistle will be a signal that it is necessary for the ship to leave the edge of the barrier. All hands will take necessary precautions.

6. Projects.

In the early stages of planning the following projects were recommended by the Bureau of Medicine and Surgery for special study during the operation.

a. To determine the practicability of garments for relatively inactive ships' crew members on exposed stations.

b. To test the protective value and practicability of cold weather gear of various number of layers and insulating material.

c. To determine the most practical and satisfactory diet for such type of operation and exploration of natural food sources.

d. To determine effect of direct and reflected sunlight and of wind on skin and eyes and evaluate methods of protection.

e. To compare warm and relatively cool barrack temperatures in regard to the incidence of respiratory infections in men working at cold outside temperatures.

f. To determine the degree of acclimatization that takes place in personnel on an expedition of this duration and nature.

g. To determine changes occurring in gingival and pulp tissue as a result of such type operation, together with a survey of the possibility of treatment of oral wounds, particularly of the battle variety in sub-zero temperatures.

Due to the shortness of time to be spent at Little America it was subsequently decided to delete those projects from the program.

SECTION II. Technical Observations

1. Medical Support of Ice Party.

a. Base Camp Dispensary. (1) The medical facilities within the base camp area were planned on the assumption that the ships of the central group would be tied up in the bay and the medical facilities of the ships would be available. However, it was realized that the ships might have to leave the ice at any time for short periods so that it would be necessary that the base camp dispensary be prepared to take care of any emergency. This actually did occur several times during the early stages of the ice operation when due to ice and wind conditions in the Bay of Whales it became necessary for the ships to leave the bay and lay to in the Ross Sea. These periods, the longest of which was approximately 48 hours, left the base camp without the facilities of the ships' sick bays.

Two weeks after setting up the base camp the ships departed from the Bay of Whales, leaving the camp without ship support for approximately 3 weeks, at the end of which time the U. S. S. *Burton Island* returned and evacuated the camp. The camp was approximately 1 mile from the ships.

(2) The dispensary was set up in a pyramidal tent with plywood floor and tent stove in the vicinity of the air operations hut. (Figs. 168 and 169.) One Navy medical officer and one corpsman were assigned to operate the dispensary and lived in the dispensary tent. Before the dispensary could operate with any degree of efficiency it was essential that the tent be improved as described in paragraph 1 of section III. When these improvements were made it was possible to operate the dispensary with a

reasonable degree of efficiency and with moderate comfort to the patient. No provisions were made for caring for bed patients. Sick call was held regularly each morning and emergencies were seen at any time during the day. In addition to the dispensary a medical corpsman was stationed at the foot of the barrier in the transportation tent during unloading operations. This was located approximately halfway between the ships and the camp and was the center of activity during this phase of the operation. He was equipped with a medical kit and was relieved every 4 hours. Personnel for this duty were drawn from the ships' complement, since the camp dispensary did not have sufficient personnel for this purpose. Additional medical equipment, including litters, splints, blankets, and a life raft medical kit, were kept at the mess tent at all times. Each vehicle operating on the ice was equipped with a life raft medical kit, which is very similar to the Army vehicle first aid kit, small.

(3) The equipment provided for the camp dispensary was divided into two main categories. The first of these included the equip-



Figure 168. Base camp dispensary (interior).



Figure 169. Base camp dispensary (exterior).

ment that was required to operate an ordinary camp dispensary and was very similar to that found in an infantry battalion aid station. The second included equipment to carry out definite treatment of a major surgical and medical nature had it been required. This latter group included X-Ray equipment, surgical instrument sets, sterilizers, etc. No emergencies occurred necessitating the use of this latter equipment but it was kept sterilized and ready for use at all times. It was not intended that this type of treatment would be carried out on the ice as long as the ships were available. The following is the equipment list of the base camp dispensary:

Navy stock number	Description	Quantity
6-125-300	Radiographic unit, portable, field, 100-volt, 60-cycle	1
7-084-275	Sterilizer, dressing, pressure, fuel heated, portable	1
7-864-635	Pad, heat, chemical	12
7-864-640	Refill for pad, heat, chemical . .	100
9-105-125	Blanket kit, canvas blankets, pack type	1
9-108-975	Blanket and bedding kit, tent . . .	1
9-114-125	Can, safety, gasoline, 1-gal. . . .	1
9-192-750	Drug set A, Field Med. Unit No. 26	1
9-193-125	Drug set B, Field Med. Unit No. 27	1

Navy stock number	Description	Quantity
9-194-650	Drug set C, Field Med. Unit No. 28.....	1
9-199-650	First aid kit, combat, pack type..	1
9-217-125	First aid kit, life raft, camof.	50
9-527-125	Splint, plaster fixation chest.	1
9-590-225	Surgical line and supply kit.	1
9-113-825	Book set.	1
9-190-550	Desk, field.	1
9-195-175	Embalming kit.	1
9-305-125	Medical outfit, aid, station and dispensary A, Field Med. Unit No. 5A.	1
9-522-675	Sick call kit, Field Med. Unit No. 11.	1
9-552-575	Sterilization and lighting outfit..	1
9-576-375	Surgical instrument kit, general surgery, Field Med. Unit No. 36.	1
7-098-150	Operating table, folding.	1
1-606-810	Penicillin sodium, 200,000 units, 10 in a box.	60
1-582-010	Albumin, serum (250 cc.).....	12
1-607-104	Plasma, normal human (500 cc.).	12
1-609-840	Streptomycin (1 gram bottle)....	500
1-165-000	Dextrose 5 percent, isotonic solution sodium chloride (1,000-cc bottle).	12
1-494-000	Whiskey (1 quart).	3
1-106-712	Brandy, 2-oz. bottle.	60
	Chapsticks, camphorated.	500

b. Special Problems. (1) *X-Ray Equipment and Supplies.* The X-ray equipment set-up was the Army portable field X-ray unit. Unfortunately a mixture of parts was shipped that did not fit and the generator was not provided. However, generators were available and it was felt that the apparatus could be made to work had it become necessary. Since the X-ray equipment aboard the ships was available whenever required, the camp equipment was never tried out.

(2) *Major Surgery.* All major surgery was performed aboard the ships where the conditions were no different from those of the average operating room in the States. During the time the ships were not tied up in the bay no surgery was required. However, the base dispensary had the equipment available and could have performed major surgery had it become necessary. Temperatures in the dispensary tent were such that it was not believed any major difficulties would have

been encountered had major surgical procedures been required.

(3) *Effect of Cold on Medical Supplies.* (a) Medical supplies kept within the dispensary tent were not greatly affected by the cold. At the temperatures encountered and with the heating facilities available the temperature within the tent was generally maintained above freezing. However, close to the floor or when the stove was turned down at night the temperatures inside the tent did drop down to considerably below the freezing point. Supplies kept out-of-doors were generally exposed to below freezing temperatures.

(b) The water packaged with plasma sets remained frozen when stored out-of-doors and sometimes froze at night when kept in the dispensary. No breakage, however, occurred. Globulin froze solid but reconstituted on heating without any noticeable change.

(c) Ointments and other substances packaged in metal tube acted in a number of different ways. Boric acid ointment was practically useless because it was almost impossible to get it out of the tube. Morphine syrettes were not affected to any great extent. Yellow oxide of mercury also remained usable. A tube of ointment (not identified), taken from the medical supplies at Little America III, which had been frozen for 7 years did not reconstitute upon warming. Green soap also froze but did not seem to be adversely affected.

(d) Tinctures and other liquid medical supplies did not freeze in the dispensary tent.

(e) An ampule of triple distilled water was placed outside the dispensary tent and observed during the operation. It did not freeze at -12° F.

(f) There were no medical department electrical generators in operation on the ice, but a number of similar units were used. No particular problems were encountered

after ordinary winterizing procedures were carried out.

c. Evacuation of Casualties. A Weasel was assigned to the Medical Department during most of the period on the ice. (Fig. 170.) This vehicle was equipped with a 1-ton sled and was also used as an ambulance. It was used as a crash vehicle and stood by at all aircraft landings and take-offs. It was equipped with a radio and contained splints, litters, blankets, plasma, and other medical supplies. Two litters could be rigged very quickly and easily on this vehicle, but at no time during the operation of the base camp was this necessary.

d. Vehicle Operations Away From the Base Camp. (See ch. 4.) Only one trail trip was made in the Central Group during this operation. This was made by seven Army, Navy, and Marine personnel in two LVT's. One member of the crew was a medical officer. No accidents, injuries, or illnesses occurred during the 250-mile trip. Sufficient medical supplies were taken to handle ordinary cases. No major surgical equipment was carried. A well equipped kit was carried in the tractor but the larger equipment, including blankets, splints, litters, plasma, etc., was carried on one of the sleds.

e. Care of the Dead. One accidental death occurred in the Central Group and the body was prepared for return to the United States. The Navy Medical Department embalmed the corpse and the body was placed in a reefer aboard one of the cargo ships. The equipment used was a regular Navy Medical Department embalming kit which included essential apparatus and fluids. The procedure was carried out by a chief pharmacist's mate.

2. Dental Service.

a. There were four Navy Dental Corps officers with the task force. Two of these were with the Central Group, one being

assigned to the U. S. S. *Mount Olympus* and the other to the task force staff. The other two were assigned to the U. S. S. *Pine Island* and the U. S. S. *Currituck*, the seaplane tenders with the Eastern Group and the Western Group, respectively. The staff dental officer made the trip from the States to the Bay of Whales aboard the U. S. C. G. C. *Northwind*. This meant that there were two ships, a destroyer, and a tanker, with each of the wing groups that did not have a dental officer aboard. In the Central Group there were two cargo ships, an ice breaker, and a submarine that did not have a dental officer. However, each group worked as a unit so that dental service was available at all times.

b. Aboard the ships dental service was carried out under conditions similar to those present in any Army camp in the States. There were no special problems.

c. After erection of the tent camp on the ice the staff dental officer set up a dental clinic in a tent adjoining the base dispensary (Fig. 171.) He had one dental corpsman to assist him. The original plan was that a standard Navy field dental unit would be set up at the base camp and routine dental treatment carried out. It was felt that this



Figure 170. Vehicle assigned to dispensary showing quartermaster sled used for transporting crash equipment.

would bring to the surface the problems of dental service that might be encountered under circumstances similar to those prevailing in this area. However, upon starting to set up the dental clinic it was found that the equipment required had either not been sent or that it had been displaced. The only equipment available to this officer was of an emergency type similar to that found in the Army "Kit, Dental Officer." He performed emergency dental treatment with this equipment and encountered no problems that could not be adequately handled. During this period the U. S. S. *Mount Olympus* was tied up in the bay about 2 miles away. When the U. S. S. *Mount Olympus* and the two cargo ships departed from the Bay of Whales, leaving the ice party ashore, the staff dental officer moved back aboard, leaving the base camp without a dental corps officer for approximately 3 weeks.

d. Prior to his departure aboard the U. S. S. *Mount Olympus* the dental officer examined all the personnel assigned to the winter party which was to remain on the ice over the winter in case it became necessary. Complete mouth X-rays were done and all indicated treatments were completed.

e. The time spent on the ice was not long



Figure 171. Dental dispensary.

and the temperatures were not extremely (low -23° F. minimum with temperatures below zero only a few days). During this time there were a few complaints of cold air causing pain in certain restored teeth, which was considered to be due to lack of an insulating material beneath the amalgam. Other than this there were no conditions that could be considered as due to the area of temperature.

3. Snow-blindness.

a. Snow-blindness did not occur during this operation. Consequently, the prescribed form for medical data on these cases was not used. The absence of snow-blindness can be attributed to a combination of the following factors:

(1) Frequent briefings and warnings, both verbal and written, made all hands thoroughly aware of the seriousness of this problem. Consequently, sunglass discipline was good.

(2) This was enhanced considerably by the habit factor. After the first week or so when carelessness might have been expected to increase, personnel at the base camp had become accustomed to wearing dark glasses and to go out without them was unpleasant. Thus, by the time the camp was evacuated it is believed that dark glass discipline was maintained more as a matter of habit and of seeking comfort from glare than through fear of snow-blindness.

(3) Around the base camp there were plenty of dark objects such as tents, supply dumps, and vehicles to provide considerable "eye relief." This factor is believed to be of some importance and may explain in large part the difference in viewpoint between those who have only lived in high latitudes and those who have spent much time *on the trail* in the same latitudes.

(4) There were comparatively few real "snow-blind" days during the time the camp on the ice shelf was occupied. Shack-

ton (*Heart of the Antarctic*) describes these days well: "When the light is diffused by cloud or mist, it casts no shadows on the dead white surface, which consequently appears to the eye to be uniformly level. Small depressions would escape the eye altogether, and when we thought we were marching along on a level surface, we would suddenly step down 2 or 3 feet. The strain on the eyes under these conditions is very great, and it is when the sun is covered and the weather is thickish that snow-blindness is produced." Prestrud, of the Amundsen Expedition, described them as follows: "To our eyes the land and sky all ran together in a white chaos, in which all lines of demarcation were obliterated . . . for the first time during the trip I had a touch of snow-blindness."

b. Dark Glasses. (1) Sun glasses worn for the most part transmitted no more than 15 percent of the visual spectrum and thus were adequate for use around the base camp. Glasses used most were: Navy N-1 goggles with polarizing, plastic lens inserts; Navy plastic sun glasses and Army M1944 sun glasses (identical items).

(2) Many personnel wore goggles with the elastic band attached through loops provided for this purpose on the Navy foul weather cap. Others attached ordinary glasses to the caps by means of elastic bands fastened between the ends of the ear hooks of the glasses and running around the back of the head in the manner of goggles. In this way when headgear was put on, dark glasses automatically went with it and were not forgotten.

(3) Goggles showed the usual tendency to fog up. The plastic glasses became scratched. Directions for cleaning them came in the cases, but under local conditions it is doubtful that they were cleaned in the prescribed manner very often. There were the usual reactions of a few whom one type or another did not fit. It is thought that the plastic

glasses showed a greater tendency to break at the junction of the temples and the lens border than is acceptable in an item designed for field military use. No statistical data are available on this point. Those required to wear corrective lenses at all times experienced the usual difficulties with clip-on dark lenses and with wearing dark glasses over the corrective pair. Personnel in this category should be provided with sun glasses having their correction ground into the dark lenses.

c. On the journey southward many informal discussions on the subject of snow-blindness took place. It was difficult to reconcile the past observations of personnel having considerable experience in high latitude trail operations with the data in reference books available on the subject. Due to the rarity of retinal damage caused by infrared radiations and the fact that snow absorbs most of the infrared while reflecting the ultraviolet wavelengths, it was generally conceded that infrared radiation could be eliminated as a contributory cause to snow-blindness. Medical textbooks generally describe it as an actinic conjunctivitis caused by the effect of the ultraviolet radiation in the sun's rays. There is some reason to believe, however, that visual radiation may contribute to snow-blindness. In support of this view a very severe case of snow-blindness was described resulting from exposure to the sun when it was barely over the horizon at the termination of the winter night at Little America. Yet when the sun's elevation is less than 20 degrees above the horizon the earth's atmosphere is supposed to be filtering out practically all of the ultraviolet wavelengths having biologic effects. It is also asked why dark glasses are required when colorless glass filters most of the ultraviolet. There are many instances in which sun "glare" was kept reduced to a comfortable degree by moderately tinted lenses with severe snow-blindness still resulting. In fact the individual on this operation who had spent more

time in the Antarctic than any other stated that he would place full confidence in a pair of dark glasses only if they transmitted no more than 10 percent of the visual spectrum. From the medical point of view the pain caused by snow-blindness does not fit too well into the clinical picture of a conjunctivitis. Although May (*Diseases of the Eye*) states that the pain, photophobia, and lacrimation may be greater than in the ordinary types of conjunctivitis, the pain of snow-blindness is repeatedly described by those who have had it and observed it as being "excruciating" and "unbearable." The following quotation from Scott's *Voyage of the Discovery* illustrates this point: "We were forced to camp early on account of it (Dr. Wilson's snow-blindness) and during the whole afternoon he has been writhing in horrible agony. It is distressing enough to see, knowing that one can do nothing to help. Cocaine has only a very temporary effect. . . ." The photophobia also is absolute, that is, it is impossible with a severe case of snow-blindness to voluntarily open the eyes. It appears possible that the intensity of visual light may play a part in causing snow-blindness and that in this condition the eye may actually be affected not only by conjunctivitis but at the same time by some other more deep-seated disturbance hitherto not well recognized.

d. In summary it should be pointed out that the dangers of snow-blindness should not be discounted as a result of experience on this expedition. Troops out on patrol over similar terrain or air-crewmembers making their way out from a forced landing on an ice cap would be likely to become casualties unless their training and eye protection are adequate for areas where there is nothing visible but white surface.

4. Other Professional Problems.

a. *Respiratory Diseases.* (1) Contrary to previous experience, respiratory diseases were

present throughout this entire operation. On former American expeditions, the personnel were few in number and were living more or less as one group. After living in intimate contact with each other for a certain length of time, upper respiratory diseases apparently disappeared entirely and did not reappear until outside contacts were again made. On this expedition the situation was entirely different. The personnel contingent was much larger, intimate contacts within a group of this size were impossible, and occasional contacts between various groups were repeatedly occurring. These factors along with the shortness of the period over which operations on the ice took place did not allow a group immunity to develop.

(2) Final figures on the actual incidence of upper respiratory diseases in the Central Group are not available at this time. However, it is known that the incidence of respiratory diseases decreased rapidly after leaving Panama, reaching a minimum upon arrival at the Bay of Whales. The rate for personnel remaining on the ice was definitely lower than would be expected in the United States and remained so until arrival at New Zealand when the rate again rose.

(3) The upper respiratory diseases that did occur were relatively mild in nature. They were mostly of the simple coryza type requiring little treatment, with occasional cases of tonsillitis, nasopharyngitis, etc.

(4) Dryness of the mucus membranes of the nose and throat of personnel aboard the U. S. S. *Mount Olympus* gave rise to considerable discomfort and comment during the ocean trip. It was generally too mild to cause the person to request treatment but was annoying and occasionally resulted in epistaxis, particularly at night. It was considered to be due entirely to the low humidity aboard ship.

b. *Shock.* No cases of traumatic shock were encountered during operations of the Central Group.

c. Accidents and Injuries. (1) There were no serious accidents or injuries that could be considered peculiar to the area or to the ice conditions except possibly for the case of a civilian scientist who fractured both malleoli of the left ankle in a ski accident. The most serious accident of the Central Group was the sudden death of a seaman when he fell into a sheepsfoot roller, resulting in a fracture of cervical vertebrae and a depressed fracture of the skull. He was riding on the roller and fell against it when the roller suddenly lurched. Another accident occurred when a hatch cover fell and amputated two fingers of another seaman. A fourth accident occurred when an officer attempted to use his finger as a drift pin and incurred a partial amputation of that finger. These last three cases could occur anywhere in the States where unloading or mechanical operations were taking place.

(2) In contrast to the above paragraph, the number of minor injuries, many of which did not require treatment and therefore were not recorded, was perhaps somewhat larger than would be expected for a group of similar size in the States. These consisted primarily of minor abrasions, contusions of fingers, and small lacerations due to awkwardness in handling tools or equipment in cold weather.

(3) This section does not include the airplane accident of the Eastern Group in which 3 men were killed and 5 of the 6 men remaining were injured. Information of this accident will be found in section IV of this chapter and in section II of chapter 6.

d. Psychiatric. There were no psychiatric conditions that could be traced to the influence of the local environment. The usual run of anxieties due to family difficulties or personal problems occurred but there were none that could be considered as peculiar to the area. The operations on the ice, however, lasted over a period of only 5 weeks and living conditions in general were good. All

of these living on the ice were busy throughout their entire stay.

e. Sunburn, Chapping, and Frostbite. (1) *Sunburn.* Sunburn was common during the first 10 days to 2 weeks on the ice. Forehead and cheeks were the principal areas affected. No severe cases were reported, and it is not felt that sunburn was a very great problem on this operation. Standard treatment was used. Prophylaxis by preventive creams was practiced very little. Further details are discussed in the report on Quartermaster clothing and equipment.

(2) *Chapping.* Chapping from wind and general exposure was common.

(a) The lips and adjacent areas were affected very little after the first 2 weeks ashore. For these areas chap sticks were used with good effect. Additional comments on this subject are contained in the section on Quartermaster clothing and equipment.

(b) Hands were affected throughout the time spent on the ice. Hangnails developed commonly. Those who used their bare hands intermittently while doing work outdoors often complained of numbness, soreness, and interference with tactile sensation in the finger tips. As far as could be ascertained there was no history of frostbite in these cases. Chapping of the entire hand and wrist was not uncommon.

(3) *Frostbite.* In February when temperatures down to -23° F were experienced there were quite a few minor cases of frostbite. Cheeks, nose, and ears were affected chiefly. One case with the toes of both feet frozen reported to the dispensary. Treatment was conservative, including bed rest in quarters for the first few days, and the patient recovered without adverse effects. The patient was an airplane mechanic. Protection for such personnel is discussed below. Face masks are of great help in the prevention of frostbite of exposed areas, but the difficulties to be overcome in regard to moisture condensing and freezing need con-

tinuing attention. No standard face mask meeting major objections has been developed as far as is known.

(4) *Others.* In addition to the conditions mentioned above, there occurred the miscellaneous medical problems that might occur in any environment. These included appendicitis, a "tumor" of the testicle, a case of jaundice, etc. These problems were met and handled just as would have been done in the States.

5. Medical Service at the Flying Line.

The base medical dispensary was located in a tent next to flight operations. The base medical officer was notified by the duty officer in operations when a take-off or landing was to be made in order that the medical officer could stand by with the crash equipment. The vehicle used was the Carrier, Cargo, M29C, track mounted, amphibious, or "Weasel." To this was attached the Sled, Snow, 1-ton, M-1. The Weasel was started and warmed up thoroughly by running 10 or 15 minutes before take-off so that no difficulty would be experienced in starting a cold motor. During a temporary transportation shortage this was used as a general purpose vehicle by base transportation but was on call to the dispensary one-half hour before a take-off or landing was to be made. During this period the medical equipment and cargo sled with all crash gear were left at the dispensary. When the vehicle was called the medical equipment was loaded and the sled fastened on. This temporary expedient was not wholly satisfactory due to the uncertainty of take-off times and landings, unavoidable delays, etc. The crash and fire fighting equipment carried included shovels, axes, asbestos suits, and five large, hand, carbon dioxide fire extinguishers, model 15-A. The medical equipment was as follows:

- 2 Folding pole litters.
- 1 Robinson type litter.

- 2 Units of plasma.
- 2 Units of albumin.
- 4 Blankets.
- 1 Thomas leg splint.
- 4 Pounds white petrolatum.
- 2 First aid kits, medical officer and corpsman, field (JAN #9-218-750).

A larger fire fighting unit was originally planned to be made by using a cold weather oil heating unit mounted on a sledge and loaded with foamite. This apparatus was found to be too heavy to be drawn by the Weasel. There were no crash landings at the base.

6. Winter Rescue Party Medical Support.

The winter rescue party was set up and organized to be activated only if it became necessary. The operation plan for the expedition called for airplane flights up to the time it became necessary to evacuate the base. In case a plane was forced down toward the end of this period and the personnel could not be returned to the base camp before it was necessary for the ships to depart this winter rescue party of 10 officers and 25 enlisted men would be activated and would remain in the Antarctic during the winter night to continue rescue operations. It was not activated.

a. Personnel. With this winter rescue party there was to be one medical officer and one corpsman.

b. Facilities and Equipment. This party was to be housed at the site of Little America III (1939-41 expedition). Some of the old buildings were to be used in addition to the double Quonset hut that was erected especially for this group. Complete equipment and supplies were placed at the site ready for the personnel to move in if it became necessary. The medical equipment was based on that regularly authorized for a destroyer with the addition of certain special items. The equipment provided was sufficient for handling practically any emergency that might arise.

Instrument sets, drugs, splints and litters, medical books, laboratory, pharmacy, and X-ray equipment, emergency dental equipment, operating room equipment, and other items necessary to provide a complete medical-service were included. In addition, other items such as a BMR machine were provided in order that the medical officer might carry out certain research problems during the winter night. For list of medical equipment, see section VI.

7. Care of Flying Personnel.

a. General. The physical welfare of the aircrews was under the direct supervision of the chief of the base camp aviation section, who arrived with the R4D aircraft on 30 January. A flight surgeon (Staff Medical Officer) was on duty ashore from this time until the ships left the bay on 6 January. Thereafter the base medical officer was available as required, it having been previously decided that a flight surgeon would not be assigned for duty with the air echelon. Each crew was made up of pilot, co-pilot, navigator-pilot, radioman, and photographer. Another crew member specializing in electronics and radar was originally planned on, but this position was eliminated by a change made before the aircraft left the carrier.

b. Physical Examinations. No special physical examinations for flying were prescribed for the aircrews either prior to or during the operation. Most of the personnel making flights had been on flying status previous to departure from the United States and their physical status was considered acceptable just as for any operation of continuing service in the zone of interior. However, the aircrews presumably underwent the same physical examinations prescribed for other personnel.

c. Quarters, Environment, and Living Conditions. The aircrews were quartered ashore at the base camp. The details of these facilities are given below. They were ade-

quate for the season and short duration of time the camp was occupied. It is believed that better acclimatization resulted than if they had been living aboard ship. This factor could be of some importance in adjusting to conditions in case of a forced landing far from base. The environment was not observed to have any adverse effect on the flying fitness of the crews. For example, the incidence of upper respiratory infections was lower, if anything, than would be observed in the northern part of the United States in winter. In this connection it should be noted that the climate at Little America in summer (January and February) is roughly the same as that usually prevailing in northern Montana, North Dakota, and Minnesota during the same months.

d. In-Flight Rations. Most exploration flights were of 8 to 12 hours' duration. Rations for use aloft were not standardized but on various flights the following were used: E rations, sandwiches, candy bars, and coffee in thermos jugs. The R4D aircraft were equipped with electric "hot cup" heaters which operated on the plane current. In addition it was found that the end of the hot air duct of the plane's heating system would heat cans of food adequately. This duct had been modified by terminating it just behind the radio operator where a curtain separated the forward compartments from the cargo section. Some of the canned rations contained beans which resulted in abdominal distress at the altitudes attained. Hot food was made available in the general mess for all crews returning from flights at odd hours.

e. Effects of Changing Barometric Pressure. There were no cases of aero-otitis or aer-sinusitis reported.

f. Effects of Decreased Barometric Pressure. The only evidence of decompression sickness observed was the abdominal pains from trapped gases reported by some after beans had been consumed as part of the in-flight

rations. There was no indication that evolve cases caused symptoms on any of the flights made.

g. Effects of Temperature. There were no reported cases of frostbite occurring during flight. However, the position of the photographer's mates in the aircraft was such that considerable discomfort and probably some loss of efficiency resulted. They were placed in the cargo sections of the cabin aft of the auxiliary fuel tanks. This section was not heated and was closed off from the forward section by a curtain. Just forward of the cargo door ports were installed on either side of the aircraft for the portable aerial cameras. Each port was rigged with a canvas baffle to occlude the space between the camera and the edge of the port. This was difficult to adjust at low temperatures, hands became very cold and stiff, and at times considerable wind blast came through the ports. Electrically heated flying suits were provided for the photographers but were not entirely satisfactory. A better method of preventing the wind blast should be sought. (See par. 13.)

h. Operational Fatigue. No objective signs of strain or anxiety were observed and no symptoms reported. After the first extended flights the difficulties and dangers involved in a forced landing in the interior were apparent to all. The likelihood that a rescue operation in some areas might be delayed indefinitely due to weather or slow surface travel, etc., was recognized by most of the aircrew personnel. The duration of the operation was comparatively short, however, and the crews were confident and had good morale throughout.

i. Noxious Gases. On flight 6A gasoline in the cabin tanks was spilled on take-off. The fumes were described as "very strong." They persisted throughout most of the flight, which the crew believed was due to the gasoline lying under the floorboards on which the auxiliary tanks were placed. On the return from this flight the pilot complained

of a severe headache and felt "rocky." He blamed it on the gas fumes. The co-pilot had a headache. The navigator had been nauseated at one time during the flight and felt "dopey" but had no headache. The radioman had a headache. The photographer first noticed a headache when about an hour out from the base, and it was not relieved until he arose the following morning. He also noticed some nausea during the flight. In addition he reported having to check and re-check camera settings to be sure they were correct, being easily winded on exertion, and that he was extremely tired on return. On the next extended flight that each member of this crew made it was found that—

- (1) The pilot had almost as bad a headache and thought his glasses were at fault.
- (2) The co-pilot "felt fine all the way."
- (3) The navigator had symptoms referable to decreased oxygen tension.
- (4) The radioman had no symptoms.
- (5) The photographer felt fine except for being tired.

A correct evaluation of the effect the gasoline fumes had is difficult since some of the adverse effects noted could be due to the altitude attained. Headache was commonly complained of on other flights. The nausea can probably be connected directly with the fumes, however. Dizziness was not complained of.

j. Effects of Decreased Oxygen Tension. (1) The R4D aircrews were given a thorough refresher briefing at the Naval Air Station, Norfolk, Virginia, on the oxygen system to be used, the use and care of regulators, oxygen masks, etc. This included explanations of the more common defects and causes of malfunction which might be encountered. Flights in the altitude chamber were made, one of which was to 30,000 feet with oxygen. They were shown mockups of various parts of oxygen systems, many of

which were defective in operation, and were required to diagnose the trouble and write down what, if anything, was indicated to adjust or repair them. Talks were given on altitude sickness and decompression sickness.

(2) Subsequently, while en route to the Antarctic, it was decided to remove the oxygen systems from the aircraft in order to decrease the take-off load. JATO was to be used, but flying the R4D from a carrier deck had never been attempted and a safety margin as wide as possible was being sought. Replacement oxygen equipment was known to be available at the base camp.

(3) On the first extended exploration flights symptoms of anoxia were reported by some of the crew members. A majority of those who experienced difficulty at the altitudes attained stated that they believed they were bothered more in this area than ever before in temperate and tropical latitudes. Several mentioned instances during the war when they had been at higher altitudes without oxygen and with less subjective difficulty than they were having at 13,500 feet over Antarctica. There was a general impression among the aircrew personnel that altitude flying was in some way different at high southern latitudes. The problem was investigated, insofar as possible with facilities available, by the following means:

(a) All crew members were interrogated after each extended flight which exceeded 10,000 feet in altitude and their statements recorded.

(b) A test flight was made on 21 February to observe the effects of selected altitudes on six subjects, principally ground crew men on flying status. The test required each subject to copy a printed paragraph in his own handwriting (about 100 words) and to work 10 simple problems in arithmetic. It was given three times, with different material to copy and different problems each time.

Immediately after take-off the first test was given to serve as a control; then a climb to 10,000 feet was made and that altitude was maintained for 2 hours. At the end of this period the second test was given, and immediately thereafter a climb was made to 13,500 feet. After 2 hours at this altitude the final test was given followed by return to base.

(c) On the return from Little America an altitude graph was made for each flight, plotting indicated (pressure) altitude against time. Data were obtained from navigators' log sheets and from photographic records made by the "gremlin" recorder installed as part of the trimetrogon camera system.

(4) Altitude graphs for many flights could not be completed with available data, and the number of flights involved was small. Therefore, no statistical analysis of the results was possible. However, the following general statements can be made:

(a) Fourteen extended flights were made during which altitudes above 10,000 feet were attained and held for over 2 hours. Most of these flights reached altitudes between 12,000 and 14,000 feet and were at these levels for at least 2 hours. The highest altitude reached was 14,700 feet. (All readings are indicated altitudes.)

(b) The principal subjective symptom reported was shortness of breath, with headache a close second. Other symptoms, in approximate order of frequency were: Fatigue, inability to concentrate and calculate, personality changes such as irritability and irresponsibility, decreased manual dexterity, and impairment of touch sensation. There was only one case of the last mentioned symptom, and that was in a radio operator who said that the key felt "velvety and slick."

(c) The crew positions, in order of the frequency with which anoxic symptoms were noted were: radio operator, navigator, copilot, pilot, and photographer. No logical explanation for this order was apparent.

For example, while co-pilots were more active during flight than pilots and navigators more active than radiomen, the photomates moved around more than any of the others and were apparently affected the least.

(d) The first seven flights were made over a period of 3 days, and the second seven over a period of 6 days. Considerably more difficulty was reported on the first seven than the second. This may be attributed to a combination of several causes. First, many were unable to get adequate sleep during the first 3 days of good weather when the main flying operation began. The crews were keyed up and tense, and long alerts were common. This situation improved progressively. Second, the early flights departed Little America at 8,000 to 10,000 feet altitude, while later more flights went out for 2 or 3 hours at 4,000 to 6,000 feet and gained altitude for mountains and plateaus only when they were reached. This was possible due to familiarity with the terrain gained from previous flights and desirable from the point of view of delaying or preventing anoxic difficulties. Finally better acclimatization may have played a part.

(e) The results of the test flight were about what would be found in temperate latitudes. A definite though moderate increase in mistakes in copying occurred between tests No. 2 and No. 3. No significant change was noted in the number of mistakes made in arithmetic. Handwriting itself was somewhat more irregular on the third test in all cases. Nothing more significant than mild shortness of breath on moving around the aircraft was complained of by the subjects at the end of the 2-hour period at 13,500 feet.

(f) Finally, factors such as lack of sleep, irregular hours, tenseness, changed environment, and a certain amount of anxiety may have resulted in an increased susceptibility to anoxia.

8. Personal Hygiene.

a. Washing and Bathing. Like swimming, the first plunge was the hardest. During the first few days on the ice one noticed that as each day passed the evidence of lack of application of soap and water to hands and faces gradually increased. After these first few days the opposite occurred and after a week or so daily washing of the face and more frequent washing of the hands became the rule rather than the exception. This, it is believed, had a very logical basis. It was necessary that individuals in each tent provide their own water by melting snow. This necessitated rounding up containers of various types for this purpose. After a few days each tent would accumulate a sufficient stock of No. 10 cans or whatever other type of containers they could procure, until they could have sufficient water on hand for washing and drinking purposes. The first face washing was quite an event and probably in most cases, for novices on the ice, took the better part of an hour to accomplish. After this first one, the next one came easier until after a few more days it was just as much of a routine and practically as simple as washing at home. Some individuals never did get into the routine and seemed none the worse for it. However, they were in a very definite minority. Bathing was a little more complicated but none the less was done without too much difficulty. On days when the wind was not blowing the temperature of the tents could be raised until one could strip and take a sponge bath with little or no discomfort. By standing on a box and raising one's self 2 feet or so above the floor, it could be made even more comfortable. To those of a more delicate nature there was the piecemeal method in which one washed one part of the body at a time and then, covering that portion, proceeded with the remainder.

b. Teeth. The purely mechanical difficulties of washing one's teeth were the cause of

delay in performing this function during the first day or so on the ice. As soon as water cans, cups (generally peanut cans), etc., were procured and arrangements completed for turning snow into water, the washing of teeth proceeded in a purely normal manner. However, if there was a tendency under normal living conditions to neglect one's teeth it was very easy under those circumstances to forget them entirely. In general, the care of the teeth was carried on fairly closely to one's normal standards.

c. Bowel Habits. The spector of an ice covered, snow filled, unheated tent latrine (or "head" as preferred by the Navy) was to practically everyone on the ice a herculean obstacle that sooner or later must be overcome. (Fig. 172.) One's first encounter was generally made after procrastination had started running a poor second to the necessity of defecation. After arguing with one's self and preparing for the worst the first venture was finally accomplished to the great physical and mental relief of the individual. After this first bout the individual bowel habits of all personnel more or less took over. The person who had developed and strictly followed a set bowel routine under more normal circumstances was definitely favored. His routine was in most cases carried out with little difficulty or discomfort. The person who had not followed a definite bowel regime under ordinary circumstances encountered much more difficulty because of the psychological obstacles which were ever present. (See sec. III.)

d. Shaving. There were three very definite schools of thought on shaving among personnel of this expedition. The first was that one should keep himself clean shaven; the second, that he should let his beard grow; and third, that it didn't make one particle of difference which he did. Among the personnel on the ice there were staunch supporters of each school, and each boasted of devotees

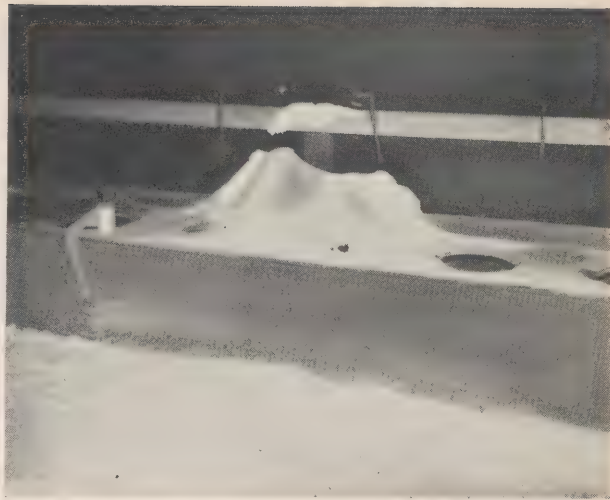


Figure 172. Interior view of latrine. This drifting occurred only during strong winds.

among the old timers as well as among the rabble. The "tonsorial exhibitionists" claimed that their beards helped protect their face from the wind, while the clean shavers pointed out that one's breath froze in the beard, which thereby must be colder besides being a nuisance. The third group let the others argue and shaved when the spirit moved them. Personally and from all the pros and cons that I could gather it all boils down to purely a matter of personal preference. However, the convenience of not having to shave is something that cannot be entirely overlooked.

e. Laundry. The term "laundry" was practically forgotten by the personnel living on the ice. The stay was so short that one's supply of socks and underwear was generally sufficient to see him through. One quickly found that it wasn't necessary to put on clean clothing as frequently as he did at home. This applied particularly to woolen underwear. To change underwear once a week was being fastidious; 2 weeks was about average. Socks were changed more frequently. Some laundry was done by individuals but generally speaking a lot of dirty clothes were either turned back to

supply or brought aboard ship. No special facilities for laundry at the camp were available.

9. General Condition and Efficiency of Troops.

The following miscellaneous points were observed on this subject:

a. Under conditions involving living in tents on snow surface, with temperatures of zero Fahrenheit plus or minus 20 degrees, working on snow surface, and no semi-permanent installations such as laundry, running water, or electricity, troops cannot do as much work as is normally the case. Keeping warm, eating, washing, maintenance of quarters, shoveling snow every other time something is done outdoors, and just daily living is much more time consuming. Everything is slowed up, and a work schedule which is normal for an average base cannot be accomplished.

b. Windy weather on ice cap terrain almost always carries drift, and the efficiency of men working outdoors drops at these times even if temperatures are moderate. In this connection it is felt that as the wind chill factor increases a point is reached beyond which it becomes less and less profitable to work troops out in the open. Experience on this operation was hardly sufficient to provide good estimates of these levels. However, if attention is given to the problem in the future, it should be possible to ascertain what wind chill value defines the approximate limit beyond which it becomes increasingly profitable to rest troops rather than work them.

c. Morale was excellent on this operation. However, it is believed that if the same type of operation were continued for several months, morale, eagerness, and contentment of the troops would require considerable effort to maintain. A few small luxuries and extra physical comforts would probably help. Just what could be provided for combat

troops that would not prove too expensive logistically would require study.

d. There was no evidence of psychological maladjustment observed.

e. Due to the necessity for melting snow for all washing and drinking water, it is believed that most of the personnel did not have a really adequate fluid intake. Many personnel very seldom took fluids except for coffee and soup at the mess.

f. It is doubtful that full acclimatization was attained even by members of the ice party. The summer season is short, and the transition to weather more severe than most have ever experienced is rapid in late February and early March. It is believed that had the party stayed on the ice through March evidences of lack of acclimatization would have become apparent.

10. Air Evacuation.

a. The only patients evacuated by air were the survivors of the wrecked PBM as described above. Nothing of note occurred in this connection except that the operation was successfully carried out.

b. In general, air evacuation from ice cap terrain is entirely feasible. In fact the ability to land on skis in many areas without preparation of a landing strip should prove an advantage over air evacuation from ground terrain; JATO can be used where loads are heavy and/or distance for take-off is limited. It is believed that glider pickups could be made as easily as on ground terrain.

c. Patient comfort could be assured by dependable cabin heating installations, and by providing sleeping bag type of bedding instead of blankets in case the heater fails or is insufficient under extreme conditions.

11. Rations.

a. Aboard Ship. The ration aboard all ships of the task force was exactly comparable to that of any Army mess in the States. Frozen meats, vegetables, etc., were used to

the limit of storage space aboard which varied from ship to ship. Fresh foods, including milk, were taken on where available also to the limit of storage space. No particular problems were encountered.

b. Base Camp. (See par. 2 of sec. III.)

(1) The ration on the ice was the best that could be obtained and handled under the circumstances. The mess in all respects was excellent and was an enormous morale factor. The ration was the regular Navy ration with frozen meats, vegetables, butter, etc. The mess officer was instructed to provide a good mess and was given authority to use a 25 percent over ration if necessary.

(2) Appetites on the ice were good. The weather combined with the excellent preparation of the food required that a ration and a quarter to a ration and a half be provided. Wastage of food after being taken on a tray was noticeably small. Preferences for particular foods were not noticeable, other than those present in any general mess, except that cold foods were not particularly desired.

(3) Frozen meats and fowl were primarily used. There were sufficient choice cuts available so that stews and canned meats were seldom served. The frozen meats were moved from the lockers aboard ship to an ice house adjoining the mess hall. This ice house was constructed by digging a hole in the snow 30 by 15 by 4 feet. A frame of 2- by 4-inch planks was placed on the snow floor to keep meat and other items out of the snow. The door was made of a single layer of wood. (Fig. 173.) Although the outside temperatures ranged from -23° to $+34^{\circ}$ Fahrenheit, the temperatures inside the ice house stayed fairly steadily around $+15^{\circ}$ Fahrenheit. It was necessary to remove the meat from the ice house and place it in the galley 48 hours prior to the anticipated time of use. This allowed just sufficient time for it to thaw and be cut. There was no spoilage.



Figure 173. Construction of cold food storage room.

(4) Bread and pastries were baked on the ships and moved to the base camp. While the ships were tied up to the ice this was done daily. Prior to departure of the ships from the bay (leaving an ice party of 200 men for a period of approximately 3 weeks) sufficient bread was baked and sent to the camp where it was stored in the ice house. This bread froze rather slowly but remained in perfect condition. It was removed from storage about 24 hours before using and even after 3 weeks it was difficult to distinguish this bread from that which had been freshly baked. This arrangement was entirely satisfactory.

(5) Canned goods were stored in the open just outside of the mess tent. This was stacked according to contents right on the snow and covered with a tarpaulin. The original pasteboard containers were used and stood up well. There was a storage tent immediately adjoining the gallery in which the temperature was kept above freezing. A 2- to 3-day supply of canned goods was kept here in order to thaw it out before using. There were no noticeable changes in the character or quality of canned foods caused by the freezing and thawing except in the case of canned milk. This evaporated milk after freezing did not reconstitute well.

(6) A number of men on this expedition had an opportunity to eat certain foods that had been left at Little America on previous expeditions. All were found to be in perfect condition and included chocolate bars 12 years old, crackers, cookies, butter, coffee, tea, and dried milk, and other items that had been in the Antarctic for 8 years. These had been stored below the surface where the temperature probably never got more than 2 or 3 degrees above zero. All of these items were just as fresh as if they had been purchased the day before. In one case a pound of butter that had been stored on the top of Mount Franklin in the Rockefellers for 7 years under only one layer of canvas was found to be perfectly fresh.

(7) Breakage of food in glass containers from the cold weather was not a noticeable problem. On this expedition items in glass containers included jellies and jams, relishes, syrup, vinegar, etc. There was considerable breakage of these items from shipping and handling but there was none that could be attributed directly to the temperature.

(8) Preparation of the ration (see par. 2 of sec. III) was excellent. It was well cooked and served hot. There were no particular difficulties encountered in its preparation that could be attributed directly to the cold.

c. Trail Rations. The only trail trip conducted on this expedition by the Central Group was one in which seven men in two "landing vehicles, tracked" (Alligators) went to the Rockefeller Mountains, a total distance of 245 miles in 7 days. Since weight was not a particularly important factor on this trip, the Army E ration was used almost exclusively. Temperatures during this trip were practically all below zero and the rations, except for the box being used, were kept out on the sled. No deterioration or change in character or quality of the E ration was noted that could be attributed to the temperature. The bread after thawing

tasted excellent but all of the crackers were broken into tiny pieces. Whether this was due to the temperature or to handling is not known.

12. Indoctrination and Training.

a. Medical Briefing of All Personnel. (1) The Medical Department has a very real and very definite responsibility in the training of all personnel engaged in an operation of this type. This will include the training and indoctrination of commanders as well as of the troops. All personnel will learn quickly once they are forced into observing the rules, but major catastrophies will occur during this phase that can be decreased in number and severity by rigid training and strict discipline.

(2) A much larger percentage of a man's working day is occupied in self-preservation in high latitudes than in the climates with which we are more familiar. This must be recognized and the necessary allowances made. Therefore, every individual must understand the basic principles of the production and preservation of bodily heat. He must understand the value of insulation and the danger of perspiration. It is not sufficient to tell a man that he should wear three pairs of socks and that they should be kept dry. He will learn this after he has experienced a few days of cold temperatures, but the knowledge may come too late to be of any benefit. In this case it will be the responsibility of the Medical Department to impress the commanders with the necessity of seeing that it is done. Exactly the same basic principles of training apply here that were used throughout the Army during the war. The only difference will be the inclusion of a few additional subjects.

(3) On this expedition a series of conferences were held aboard ship during the trip to the ice. This was the only formal briefing of personnel in the Central Group. These conferences included subjects of general

interest presented by the geologists, naturalists, and other scientific personnel and also a series of talks on clothing, frostbite, protection of the eyes, sunburn, and mechanism of heat production. Also included were a number of training films on trench foot, first aid, shock, and so forth. These are the obvious necessities of training for high latitude operations. All training for cold weather operations should point toward getting the men in the field under cold conditions.

b. Special Training for Medical Department Personnel. (1) Training of medical department units for high latitude operation will for the most part be based on the same training program as provided for all troops. This will cover most of the problems encountered by medical units. Certain instruction will be required in nursing care in cold weather and in the treatment of certain cold weather conditions.

(2) For commissioned personnel instruction in metabolism and the production and preservation of body heat should be given. Types of diets and caloric and vitamin contents of foods should be included. Peculiarities of medical service in cold weather as brought out in all of the various high latitude operations should be consolidated and presented in any training program. The etiology, pathology, and treatment of conditions found in these areas should be reviewed. In addition to these specific medical responsibilities, it is believed that every medical officer going into high latitudes should know the basic principles of navigation and radio operation, including the ability to receive and send CW messages. It may happen that a medical officer may find himself the only officer present in a small isolated unit such as a trail party, a rescue party, etc., and a knowledge of these two subjects may mean the difference between life and death.

(3) In the training of an Antarctic expedition it is felt that the writings of such men as Scott, Amundsen, Mawson, Shackleton, and Byrd should be required reading. There is an enormous amount of information to be gathered from these writers, both from the things that they did well and the mistakes that they made. However, a large group of men with polar experience will be the greatest asset to a high latitude training program.

13. Air Force Types of Clothing and Personal Equipment—Central Group.

a. Flying Equipment. (1) As noted above there were no oxygen systems installed in the aircraft. Neither were there walk around bottles. Consequently, no observations were made on oxygen masks, regulators, etc.

(2) Aircrew personnel were equipped with polarized plastic lens sun glasses with plastic bows, which transmit about 15 percent of the light of the visible spectrum. The spare pair carried in the survival gear was of the same type.

(3) Most flying was done in woolen underwear, O. D. trousers and shirt, Navy issue winter flying boots, and the Navy leather flying jacket or pile lined field jacket. Flying helmets were not used to any great extent. When the heating system failed or was inadequate the crewmen could resort to their kit bag of spare clothing.

(4) The Navy leather-covered, electrically heated flying suit and electrically heated gloves and shoes were available for wear by the photographer's mates as mentioned previously. They were found to be awkward at this position, especially when attempting to adjust the wind baffles at the camera ports, and the cameras themselves. The photographers also had to move back to the tail section to the trimetrogon camera installation, which required disconnecting the current. Hot and cold spots in the suit

were commonly reported, and a need was expressed for temperature regulation to the hands and feet.

(5) Photographers and radio operators both saw a need for a fairly thin glove that would afford some degree of protection when they had to work without mittens at low cabin temperatures.

(6) A few samples of the Army H-16/U headset were tried and found to be uncomfortable as to fit at the ears. Otherwise they were apparently satisfactory.

(7) *Sanitary Devices.* The standard R4D relief tube installation was modified by substituting a larger tube (about the size of a garden hose) and locating it in the main fuselage section opposite the cargo door. A larger funnel also was used. While this modification was an improvement over the standard, still further development appears to be indicated for this type of operation. Even the large size tube became stopped up frequently, and there was considerable wetting of the aircraft and adjacent equipment. The tubes were installed in such a way that fluid stasis and freezing occurred in various parts of the tube. Some method involving a relatively straight gravity drop and at the same time precluding the possibility of the tube's remaining bent when secured to the airplane would be desirable. Even with these specifications it is possible that with temperatures of -40° to -50° C. and eight men in the crew freezing would occur rapidly enough to stop the tube on a 12-hour flight. (On one flight outside temperatures below -40° C. were recorded.) The inconvenience under conditions encountered of procuring boiling water to clear the tubes after landing would be considerable. Possibly the solution lies in providing waterproof paper bags of suitable dimensions—each one to be disposed of after a single use. Paper sacks were provided for defecation but were seldom, if ever, used.

b. Suitability of Clothing for Existence After

Forced Landing. (1) Most items were adequate insofar as the services have been able to make them to date. Of course, in the more extreme Antarctic weather caribou clothing and sleeping bags would be better. On one extended flight a pilot had to resort to his sleeping bag to get warm when the heating system failed, and obviously the furs would become even more important in case of being forced down in the interior. Unless the season and temperatures are favorable, as was the case when the PBM crew went down, electrically heated suits are not suitable as to type or warmth. It is believed that for polar flying electrically heated garments should be second choice or special purpose items, and clothing suitable for both flying and ground survival be selected for routing operations. This may involve compromises at first and a certain amount of new development as a continuing policy to meet the demands of high latitude operations.

(2) The immersion suit is required for emergency landings under certain conditions. (Fig. 174.) The operations of the Central Group did not require it. However, the Underwater Demolition Team tested two immersion suits in the waters of the Bay of Whales (fig. 175). They did not have the flotation feature, as they were designed for underwater swimming. They were cut to conform closely to the contours of the body and had a valve for the release of air trapped within the suit. A design for sealing the free margin around the face was found to be effective. One type was one-piece rubber with a thin cloth lining. The other was two-piece and not lined. Gloves and feet were a part of each suit. Under the suits were worn two pairs of woolen socks, one suit of woolen underwear, and one pair of knitted gloves. Conditions at the time of the tests were: air temperature $+26^{\circ}$ F., water temperature $+29^{\circ}$ F., and the water covered with 2 inches of slush ice. Fifteen men swam for 20 minutes each during the

test. There was no sudden sensation of cold and cooling was subjectively gradual throughout. In 7 to 10 minutes discomfort in the extremities began to be felt, and by the end of the 20-minute period hands and feet were "very cold." There were no subjects who shivered at any time. Respirations, pulse rate, blood pressure, and mouth and rectal temperatures were recorded before and after the test. Changes in these readings were in all cases within the limits expected after the amount of exercise involved, except the oral temperatures which dropped slightly—apparently due to direct contact with cold water.

c. Ground Crew Problems. The principal problem in aircraft maintenance was keeping the mechanics warm. Shelters for the mechanics were improvised but were not entirely satisfactory. (Fig. 176.) Various methods were discussed with personnel on the job.

(1) The difficulty of handling nuts, bolts, and screws was emphasized by all. One suggestion made was to develop a light glove to insert to cover the hands and help to some extent when otherwise bare hands would have to be used.

(2) For the same problem the development of a universal tool for putting on nuts and bolts was suggested.

(3) Several mechanics who were shown a heat block evidenced considerable interest. This item is made by a mine safety appliance company. It is a metal block which is heated by discharging a cartridge inserted into a hole in its center. They thought it might contribute to overcoming heat loss to cold tool handles if screw drivers, etc., were bored and fitted for this cartridge.

(4) A heated tool box or cabinet was suggested but most of the mechanics felt that an adequate nose hangar would solve most of their problems.

(5) The consensus was that a nose hangar should be provided with the following points incorporated in its construction:

(a) It should cover both ends of the engine.



Figure 174. Immersion suits.

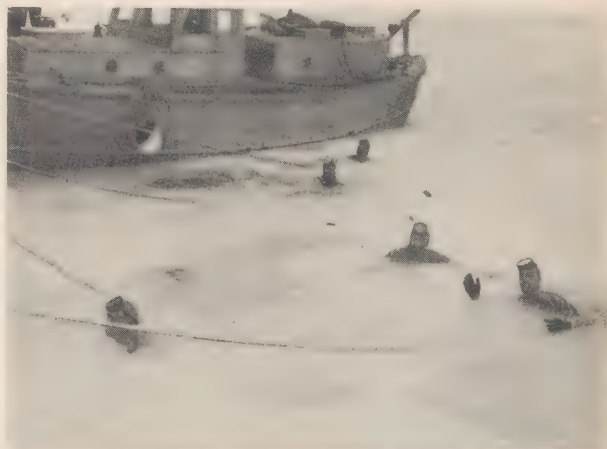


Figure 175. Immersion suits being tested. Note slush ice on surface of water.



Figure 176. Improvised nose hangars for protection of aircraft maintenance personnel.

(b) It should have a catwalk over the wing if possible.

(c) The canvas should be windproof.

(d) For ease in moving it should be built on skis or skids or else adaptable to runners of some type.

(e) Openings for Herman-Nelson heaters.

(f) All four sides covered.

(g) Windows on all sides to take advantage of 24 hours of sunlight when available.

(h) A means of anchoring to resist very strong winds. Estimates by crew chiefs, line mechanics, and engineering officers as to how much the above type shelter would raise efficiency of maintenance crews varied from 50 to 90 percent.

(6) One airplane mechanic froze his toes badly enough to require treatment in bed. Most of the mechanics wore boot packs—either the Quartermaster issue or similar type. This item should be adequate for ordinary temperatures down to zero degrees F. if heated engine hangars are available. However, under more severe conditions mukluks should be provided for those working on aircraft.

d. *AAF Clothing Worn by Observers.* Prior to departure the 12 War Department observers were supplied with several items of personal gear which were developed by the AAF. These were worn mostly on the ground in combination with Army Quartermaster and Navy clothing. Most items were furnished in only one size, which resulted in less utilization of these garments than would have been possible otherwise.

(1) *Jacket, Mechanic's, Arctic, Type D-2* (fig. 177). This jacket was worn only in the coldest weather. With the exception of fur parkas, and the Quartermaster Arctic parka, which are warmer, this was the warmest standard garment of jacket type in use. Since they were worn by observers who were in and out of shelter frequently on an average day, the slip-over type was not so well liked

as the type which opens all the way down the front. Fastenings were adequate and functioned well. The fur along the border of the hood serves its purpose well. Two subjects thought that a draw string at waist level or slightly below would be an improvement in windy weather. The two who mentioned this point are of less than average weight for their height. The chest pocket was appreciated.

(2) *Jacket, Flying, Winter, Type B-11.* This jacket was worn more than the above—probably because only on a few days were temperatures below -10° F. recorded. There were a few complaints that the hood “pressed down” on the head when in use, indicating that for these wearers the top of the hood to neck seam measurement was too short. Buttons and zipper worked well. The warmth of the jacket was increased by wearing a scarf, since the neck closure



Figure 177. Jacket, mechanic's, Arctic, type D-2.



Figure 178. Cold weather clothing: shoes, flying, winter, type A-6A; suit, flying, light, type L-1, gabardine; goggle, assembly, flying, type B-8. Note parka, hood, heavy, alpaca lined, type N-1, underneath flying suit.

admits wind. It was thought that the lower pockets would be better if deeper.

(3) *Shoes, Flying, Winter, Type A-6A* (fig. 178). This item was worn quite commonly by several observers. Although not designed for continuous use on the ground, it served well for wear around the camp. It is not well adapted to ground survival in its present form. This shoe was worn experimentally with impermeable rubber stockings by two observers.

(a) The following assembly was worn by one observer:

Right foot: Light weight inner stocking, rubber stocking, one pair heavy woolen ski socks, winter flying boot.

Left foot: Light weight inner stocking, two

pairs of heavy woolen ski socks, winter flying boot.

It was found that the heavy woolen sock on the right foot was perfectly dry at night. The outer sock on the left foot was very damp. Both light inner socks were moderately damp and to the same degree. Under the circumstances worn—walking and frequently going in and out of tents, huts, etc.—there seemed to be little difference in the warmth of the above combinations. If there was any difference in warmth it favored the right foot. There is little doubt that if a person walked actively long enough to perspire freely and then stood around quietly for an hour in temperatures around $+15^{\circ}$ F., the evaporation from the damp woolen socks would make it much colder than the foot with the rubber sock.

(b) The assembly first tried by the other observer was rubber stockings and winter



Figure 179. Mask, face, cold weather, type D-1.

flying boot only. This was comfortable until temperatures dropped below zero and the shearling lining became matted down on the sole. At this time he changed to light woolen socks next to the skin, rubber socks over that, felt duffel socks next, and the flying boot last. This assembly was comfortable under conditions of considerable outdoors activity and temperatures from zero to -23° F.

(c) It is believed that the principle involved in having an impermeable layer near the



Figure 180. Other types of cold weather clothing: boots, mountain, ski (QM); trousers, mountain, ski (QM); mitts, shell, trigger finger (QM); jacket, flying, intermediate, type B-15. Note parka, hood, heavy, alpaca lined, type N-1, underneath flying jacket.



Figure 181. Parka, hood, heavy, alpaca lined, type N-1. This vest type garment is easily and comfortably worn alone or under any type outer garment. Sun glasses are Quartermaster issue.

skin and most of the insulation between it and the outer covering might be tried with benefit in the future development of footgear for flying.

(4) *Mukluks, Winter, Flying (Spec. No. Y-3269)*. These boots were delivered without the inserts designed to be worn with them. However, locally available socks were used and were satisfactory. No complaints or suggestions for improvement were noted, and although the change to mukluks was a welcome one when temperatures were below zero, it is not felt that the operation afforded the chance for a thorough test.

(5) *Mask, Face, Cold Weather, Type D-1 (fig. 179)*. This item was worn on a few occasions and appeared to be very helpful. However, there was no opportunity to use it under extreme conditions and for long periods of time. The usual difficulty in wearing dark glasses with a mask was experienced.

Work should be continued toward developing improved face masks.

(6) *Intermediate Flying Jacket, Type B-15* (fig. 180). This jacket was used a great deal, especially on shipboard between 45 and 65 degrees S. latitude. It was also worn quite often around the base camp. Comments on it were uniformly favorable.

(7) *Parka Hood, Heavy, Alpaca Lined, Type N-1* (fig. 181). This item was also worn a great deal and was praised highly by all who tried it. It has been suggested that it would be useful as a head covering while in a sleeping bag, since it would "follow" more readily when the wearer turned over. A similar garment made by the Navy was worn by the aircrew personnel, but as far as is known no one had the opportunity to wear both for comparison. No suggestions for improvement can be offered.

(8) *Glasses, Arctic, Sun, Type F-1*. This glass was liked by all except one person, on whom the nose arch was uncomfortable. Horizon identification under adverse conditions was better than with others tried.

These others were mostly Army Quartermaster or Navy issue with plastic lenses. The Navy neutral gray flying glasses were worn by only a few persons, and no comparison was feasible. The lenses of the F-1 glasses transmit about 15 percent of the light of the visible spectrum, and it is possible that if survivors of a crash were wearing them in areas completely covered with snow and ice, they might not surely prevent snow-blindness. On "milky" days when the sun is not visible and there are no shadows and no contrast between snow and sky, the light intensity and strain on the eyes are markedly increased. Under these conditions a lens transmitting no more than 10 percent of the light may be required. Of course, in an airplane the cockpit cuts out the light from quite large angles, both above and below the wearer, and the above would not apply. There is some difficulty in wearing the F-1 sun glasses with heavy winter headgear. Their utility could be increased by modifying them to be worn either in the conventional manner or by an elastic retention band running around the head outside of the headgear.

SECTION III. Environmental Sanitation^{*}

1. Shelter and Housing.

a. Shelter and housing was provided by a combination of tents, Quonset huts, Wannigan huts, and improvised shelters. Quonset huts were provided for the emergency camp, and for air operations and communications. Wannigan huts were provided for the four senior officers living on the ice and pyramidal tents for the remainder of the personnel. Improvised shelters made from two-by-four's and canvas were erected for the vehicle maintenance shop and clothing

supplies. Ward tents and storage tents were used where more space than that provided by pyramidal tents was required such as aviation maintenance shop, mess, etc. These housing facilities were adequate for the conditions that were encountered and for the length of time that they were used. However, a number of improvements could be made that would greatly increase their efficiency.

b. The tents provided for personnel in the base camp were the standard Navy pyramidal 16 by 16 feet. They were erected in 5 rows of 10 tents each, the rows being

^{*}See chapter 3.



Figure 182. Living quarters, showing base frame of two-by-four's.



Figure 183. Living quarters, showing wall of snow blocks around entire tent for insulation purposes.



Figure 184. Entrance to living quarters (tent), showing door made of plywood and lumber scraps.

200 feet apart and the tents within the rows 40 feet apart. These distances were used because of the fire hazard and to decrease the accumulation of drifted snow. The distance between the rows of tents caused

the camp to be spread out over a very large area, and it might be decreased to some extent without causing too much accumulation of drift. The rows ran in a northeast-southwest direction with the doors of the tents facing the northwest. The prevailing winds were from the south and east. The tents were erected on a flat ground frame of two-by-four's on which was placed a plywood floor. (Fig. 182.) Extending out from this frame was an additional frame of timber to which the tent ropes were tied. Each tent was provided with an Army tent stove M1941 which burned Diesel fuel, standard Army cots and mattresses, and an Army sleeping bag M1942 with inner and outer shell or a Navy sleeping bag with an outer shell and an inner pad. This was what one found upon moving into the tent.

c. One could not live comfortably in a tent in this state for very long under the conditions that were encountered. The comfort of the tent depended upon the time available, the energy expended, and the ingenuity shown.

(1) The first improvement necessary was to build a two-by-four frame around the inside of the tent about 4 feet off the floor. This



Figure 185. Hospital tent, showing entrance formed by snow blocks to break the wind. Plywood door on inside completes this entrance.



Figure 186. Living quarters, showing oil drum connected to heating unit inside tent.

was essential because of the wind and the accumulation of snow against the outside of the tent causing it to sag. In some tents where the personnel were fortunate enough to find sufficient plywood a wall was constructed on this frame which was of great benefit. This frame was also useful as a clothes rack and for placing shelves.

(2) The canvas flap door is entirely inadequate for this region. A 12-inch snow drift could easily accumulate in one's tent during a moderate wind if an improved entrance was not provided. These entrances showed great ingenuity and in some cases considerable labor was involved. The best type was one in which a plywood frame was constructed with the door almost horizontal and which led down 3 or 4 steps into a pit and then back up into the tent. Other types were made from plywood, snow blocks, packing cases, or combinations of all. Some had as many as three doors or flaps. All were intended to keep out the snow and wind and worked very satisfactorily. (Figs. 183, 184, 185, and 186.)

(3) Other measures for windproofing consisted of chinking the cracks in the plywood

floor with canvas, cloth, paper, wood, or anything at hand. Snow walls around the outside of the tent built up to a height of about $4\frac{1}{2}$ feet helped a great deal during strong winds.

(4) During blizzards the metal cap, placed at the apex of the tent for the purpose of holding the stovepipe, allowed a great deal of wind and snow to enter the tent. This caused considerable discomfort and various means were taken to remedy it. One method was to place two of the regular canvas covers so as to cover the spaces between the tent and the metal cap. Another was to take the mosquito bars that came with the cots (since the mosquito bars were not needed for their intended purpose many other uses were found for them) and stuff them into the space between the metal cap and the tent. This worked fairly well but was dangerous because of the fire hazard.

(5) Because so much of the heat from the stove was lost in the upper part of the tent, false ceilings were erected in a number of the tents. These were made of mosquito bars, mattress covers, lead foil covers of storage batteries, and tin foil radar reflectors. Some of

these were very successful and made a noticeable difference in the temperature of the tent.

d. When these improvements were completed one could sit comfortably in these tents in temperatures down to zero degrees Fahrenheit with heavy underwear, wool shirt, and trousers, and possibly a sweater. The area up to about 12 inches above the floor, however, seldom got above 32 degrees Fahrenheit and the corners of the tent were generally fairly close to outside temperatures. But sitting up within 3 or 4 feet of the center of the tent it was generally sufficiently warm



Figure 187. Interior view of living quarters, showing improvised furniture and plywood floor.



Figure 188. View of mess tents from the southwest.

to read or write and live a fairly comfortable life. In colder weather or when there was a strong wind the side of one's body away from the stove was generally cold unless additional clothes were added.

e. Because of the necessity of keeping the tent closed tightly it was necessary either to keep a lamp burning at all times while working in the tent or to provide some type of windows. The latter method was very highly desirable. This was accomplished by cutting holes in the tent and lacing lucite into the hole. Windows of various sizes from 6 inches square to 2 feet square were made in this manner and worked very satisfactorily. Because of the 24 hours of daylight it was necessary to provide means of covering these windows while sleeping. Gasoline mantle lanterns were also used which worked well but considerable maintenance was required.

f. The Army tent stove (M1941) converted for use with Diesel fuel worked satisfactorily. After the tents were "winterized" it was seldom necessary to run the stove at full heat. However, one side of one's body was frequently cold while the side toward the stove was too hot. In many cases one might be fairly comfortable up close to the



Figure 189. "Chow line."

stove while there was a quarter of an inch of frost on the inside wall of the tent. Numerous carbon monoxide determinations in the tents made at various levels, at different temperatures, etc., did not reveal a single positive reading. Only a few stoves required maintenance during their 5 weeks of continuous use. The tent pole, however, in a few tents did require some maintenance. The way the stove pipe leaves the tent requires that the stove and the center pole be placed very close together. When the stove is turned on high it scorches the pole and in a few cases they were burned through. Due to the fact that it required some time to start these stoves, they were generally turned down low rather than turning them out at night. This also provided some heat in the tent during the night.

g. Other improvements which tended to make tent life more comfortable included: A broom and a whisk broom, if they could be obtained, for cleaning off snow; tin foil reflectors around the edge of the tent; water drains through the floor of the tent; furniture such as chairs, tables, shelves, etc., made from packing cases; and a clothes drying rack up high in the tent for drying socks, inner soles, and shoes. Many men also raised

their cots off the floor by means of a 10- to 12-inch platform. This provided a large amount of "off the floor" storage space under one's cot. (Fig. 187.)

h. The Army and Navy sleeping bags were both satisfactory for the temperatures and conditions encountered.

2. Messing.

a. Messing was accomplished in a combination of tents joined together and constructed on a wooden two-by-four frame with a plywood floor (see ch. 3). (Figs. 188 and 189.) This unit was located at the southeast corner of the camp.

b. Wooden doors were constructed for the mess tent in order to conserve heat to a point where one could eat comfortably. Heating was accomplished by the field ranges in the galley and three space, oil fired, radiant heaters. These heaters accomplished their purpose, although most people ate without removing their heavy clothing. (Fig. 190.) Electric lights were provided throughout the mess by means of a generator set up in a tent just outside the galley. Mess tables were of the standard field design made of two-by-four's with a masonite top. The plywood floors became wet during the first few days,



Figure 190. Mess tent, showing tent frame, mess table, metal trays, and other table equipment.



Figure 191. Army field range in mess tent converted to burn Diesel oil.

from the snow that was carried in on the shoes of the personnel, and did not dry during the entire stay on the ice. This caused a very difficult situation when the temperature dropped low enough to require that mukluks be worn. They became wet when worn on this floor and lost their usefulness. The mess was operated 24 hours a day throughout the entire period. During the first part when



Figure 192. Messing gear in mess tent. Equipment was similar to that found in any field mess.



Figure 193. The mess tent was scrubbed and cleaned following each meal. Working tables, eating tables, benches, etc., were made from plywood and odd lumber.

24-hour working parties were being used, a full hot meal was served at midnight. After the night shift was cut down to essential communications and maintenance personnel, only soup and fruit were served at this time. However, the mess was always open and coffee, bread, butter, and preserves were always available.

c. The galley was equipped with six Army field ranges which were converted to burn Diesel fuel (fig. 191). These ranges performed well and no special cold weather problems were encountered. However, it was necessary to detail one and sometimes two men on each shift to devote their entire time to maintenance of these ranges and the three space heaters. The other equipment in the galley was the same as that found in any field mess (figs. 192 and 193). The only mechanical device used was a bread slicer. The actual mechanical process of preparing the food presented no special problems.

d. The food was served direct from the field ranges to the individual trays (figs. 194 and 195). The trays, which were of



Figure 194. Meals are served hot from the Army field ranges. Note men in mess line continuing to wear their heavy cold weather clothing.



Figure 195. Hot food did not remain hot long when served on individual metal trays. Note man being served, retaining windproof suit for added comfort against cold of mess tent.



Figure 196. Interior view of mess tent, showing accumulation of frost.

the six-compartment, metal variety, were located just inside the door of the serving tent and the field ranges were at the junction of the serving tent with the galley. Although the food was served hot, it cooled very quickly on the metal trays. Generally, before one could finish eating, the food was cold. (Fig. 196.)

e. Dishwashing was done partly by the individuals and partly by K. P.'s. This was done at the end of the enlisted men's mess where two GI cans, one soapy and one clear, were kept hot by field range heating units. Individuals washed their own trays, but silver, bowls, and cups were washed by the K. P.'s. (Fig. 197.) All the kitchen equipment was also washed here. The problem of providing sufficient water was a big one which made it necessary to use the same water for more personnel than was considered desirable.



Figure 197. Dishwashing.

f. Disposal of trash such as pasteboard cartons, large tin cans, etc., was done by burying. Since freezing occurs very quickly, no problem in sanitation is involved. All that is necessary is to dig a hole; drift will

cover it over only too quickly. The disposal of garbage, wash water, cereal boxes, cream cans, and other small items cleared from the mess tables was accomplished by a method which is peculiar to the areas where this type of snow formation is found. (Figs. 198 and 199.) At first only hot wash water was poured on the surface of the snow. This immediately produced a hole about 3 feet deep and a foot in diameter. After one day the hole was deep enough to pour in the garbage and other items. As time went on the hole became larger and larger until it seemed to strike an equilibrium. At this point the surface of the refuse was about 10 to 15 feet below the surface of the snow. There then developed a tendency to throw pasteboard boxes, etc., into the hole and it started to fill up but when this was stopped the surface of the refuse gradually receded. If only wash water and liquid garbage were



Figure 198. Garbage and waste disposal.



Figure 199. The disposal pit grew deeper as it was used.

disposed of in this manner, it is believed that it could be continued indefinitely.

3. Water Supply. (See ch. 3.)

a. On the ice, water was obtained by melting snow exclusively. No regular snow melters were employed and the production of the amounts of water necessary for the mess was a long and arduous process. The heaters used for this purpose were located in an improvised open top shack about 100 feet east of the mess hall. (Figs. 200 and 201.) This placed the source of the snow used in producing the water on the southeast corner of the camp. This was the ideal location. Since the prevailing winds are from the south and east, the debris from the camp was not blown into the area. The shacks were for protecting the personnel operating the heaters from the wind.

b. The density of the snow increases as the depth below the surface increases. Just below the unpacked surface snow the density is from 0.2 to 0.3. At 6 feet this increases to 0.4 and at 20 feet to 0.5. Therefore, the snow blocks that are cut close to the surface will produce 0.2 to 0.3 of a cubic foot of water for each cubic foot of snow.

c. Two types of heaters were used. The most efficient one was an "Aeriol" steam



Figure 200. The snow melting plant.

heater which burned kerosene and produced steam under 30 pounds of pressure. There were two of these units and they would each produce a 32-gallon G. I. can of water in about 15 minutes. However, considerable maintenance of these units was required, so the other type, which was the regular Army immersion heater converted to use Diesel fuel, was also used. Each of these units would produce a G. I. can of water in approximately 1 hour. These immersion heaters were also used to keep the water from freezing until it was needed in the mess tent.

d. In individual tents water was produced for drinking and washing purposes by melting snow in any type of container available. This was done on the top of the tent stove. The most efficient method of doing this is to have a small amount of hot water in the can and then add snow blocks. This will also prevent burning out the bottom of the can. A can of water, if placed on the floor and left overnight away from the stove, would freeze before morning.

e. In providing for the water supply of a camp of this type it is important to choose the site on the windward side as soon as the camp site is chosen and to mark off this area to prevent contamination.



Figure 201. Interior view of snow melting plant.

f. No bacteriological tests or tests for mineral content were done and no purification measures were employed.

4. Disposal of Human Waste.

a. To the uninitiated the problem of defecation on the ice was one that was looked forward to with considerable concern. Actually, however, after arrival on the ice it was found to be much simpler than anticipated.

b. The sanitation problems in connection with the disposal of human waste, as we generally understand them, are practically nonexistent in the Antarctic. This is due to the fact that urine and feces freeze very soon after being deposited and there is no period of the year that thawing occurs. The temperature may rise above freezing for an hour or so on occasional days during January or February but the mean temperatures for these 2 months, which are the warmest of the year, are 21.5° Fahrenheit and 6.5° Fahrenheit, respectively. Because of this the problem of insect breeding, odors, etc., are absent. The problem of contamination of water supply is solved simply by preventing the deposit of urine and feces in the area from which snow for making water is being taken.

c. Three latrines were constructed in the camp area with a fourth in the area occupied

by the shops and air operations activities. (Fig. 202.) There was one latrine for 50 officers and two latrines each serving 100 enlisted personnel. These latrines were of the pit variety with 18 to 20 seats. The pits were approximately 5 feet deep and 3 feet wide and were covered with a box very similar to the standard quartermaster latrine box of the Army except that no lids were used. The latrine was covered with a standard 16- by 16-foot pyramidal tent in which was placed a plywood floor exactly like the ones in the living quarters. The seats were arranged around the edge. The rules for constructing pit latrines such as the spacing of supporting timbers, urine baffle plates, etc., apply here as elsewhere. No urinals were provided.

d. Odors were practically unnoticeable. Occasionally, in the morning after several people had used the latrine there was a slight odor which disappeared shortly afterward.

e. No heat was provided in the latrines and no improvements made to the tents as there were in the living quarters. Snow quickly accumulated around the entrance and inside, at times covering practically all of the seats. Regular maintenance is required.

f. Due to the rapidity with which feces freezes, it builds up in a stalagmite formation



Figure 202. Outside view of latrine, showing snow drifted after blizzard and accumulation of snow on tent in which there was no heat.

reaching considerable height very quickly.

g. Urination was carried out wherever one desired. This was generally around the outside of the individual tents. In some cases where a snow surface was available in the tunnel forming the entrance to the tent, a "urinal" was made simply by urinating in this snow. The heat of the urine quickly forms a hole of considerable size. On the outside of the tent the urine gives a definite yellow color to the snow that shows up as numerous colored spots on the surface. Occasionally, while getting snow for producing water in the individual tents one encounters one of these frozen urine deposits. Urinals for the individual tents should be provided.

SECTION IV. Survival and Rescue

1. Survival Planning and Equipment, Central Group.

a. The medical equipment carried aboard the R4D aircraft consisted of—

- 5 First aid kits, aeronautic.
- 12 Gauze roller bandage, 2 inches by 6 yards.
- 10 Two-ounce bottles of brandy.
- 1 Bolt absorbent surgical gauze 1 by 25 yards.
- 2 Boxes morphine tartrate surettes (5 per box).
- 4 Large battle dressings.

- 1 Bottle of 100 sulfadiazine tablets, gr. 7½
- 1 Bottle of 50 aspirin tablets, gr. 5.
- 1 Pound boric acid ointment.
- 1 First aid pamphlet.
- 5 First aid kits, individual aviator (stored in aircraft, but not carried by the individuals themselves).

All of the above items except standard aeronautic first aid kits were removed from aircraft and stored at the dispensary between flights.

b. For aircraft emergency survival equip-

ment carried on all R4D flights see paragraph 6c, section III, chapter 6. Also see figures 203 and 204.

(1) The sleds were made especially for this operation for use as aircraft emergency survival gear. They were fashioned after the Nansen type, which is very light. In comparison to the Quartermaster man-hauling sledge they are longer, and at the same time somewhat lighter. In their length they had the advantage of being capable of carrying a man lying at full length. A similar sledge used on a previous expedition (Byrd—1940) was considered for this operation, but insufficient time was available for its construction.

(2) White gasoline was contained in the cans carried as survival equipment. Eliminating this weight and depending on the 100-octane fuel in the tanks was considered, but the performance of the Coleman stove on leaded gasoline was thought to be too uncertain. Primus stoves which operate well on 100-octane gasoline are believed to be available, and should be procured for polar flying operations if adequate Army equipment is not already available for this use.

c. In addition to the above, each R4D crew member was responsible for loading extra items of personal clothing before each flight. (Fig. 205.) These were kept in parachute kit bags and stored between flights in the quarters of the individual crew members. (See list below.) In this connection it was noted that on the flight in from the carrier at least one crew had a complete change of extra clothing packed in a waterproof bag so that they would have an immediate change available if they had to ditch and became wet in the process.

Emergency Survival Clothing	
Item	Number
Shoe liners, felt.....	3 pairs
Mask, face.....	1
Cap, knit, watch.....	1
Mittens, wool, inner liner.....	2 pairs
Glasses, sun.....	1
Mukluks, canvas.....	1 pair

Item	Number
Inner soles, mukluk.....	1 pair
Booties, felt, mukluk.....	1 pair
Scarf, silk.....	1
Mittens, outer.....	1 pair
Shirt, wool (Army issue).....	1
Socks, double sole (light weight).....	1 pair
Socks, wool (short length top).....	2 pairs
Socks, wool (long length top).....	2 pairs
Trousers, wool (Army issue).....	1 pair
Underwear, wool, long length.....	2 pairs
Sweater, wool (Army issue).....	1
Boots, ski.....	1 pair
Parka, windbreaker.....	1
Parka, inner.....	1
Jacket, field, pile lined.....	1

These items were the minimum required to be carried by each crew member on each extended flight. This list was in addition to a complete outfit being worn by each crewman. Individual aircrew members often



Figure 203. Interior view of R4D (C-47), showing stowage of portion of survival gear.



Figure 204. Display of R4D emergency survival equipment.

added small items to this list such as cigarettes, soap, extra socks, etc.

d. The survival rations originally planned for the R4D aircraft were considered too heavy for their caloric content, and in some instances not practical for the conditions under which they were to be used. Accordingly, after consultation with personnel having experience in Antarctic sledging, flying, and tracked vehicle operations, the rations were revised. (Fig. 206.) Availability decided the choice of some items. The bacon was sliced to make it easier to handle when frozen, cheese was removed from the tin containers (as furnished in the K ration), bulk coffee was eliminated because of its weight, evaporated milk was dropped because of being hard to handle when frozen, jam was eliminated because of high net and gross weight compared to its caloric content, and difficulty in handling frozen, etc. Oatmeal was packaged by utilizing large white windproof mittens as sacks. The revised



Figure 205. Officer loading personal survival clothing.



Figure 206. Aircrews working on assembly of revised survival rations.

ration represented a saving of 15 percent in gross weight and at the same time an 8 percent increase in caloric content. A detailed list and calculation of ration is given in table I. Each complete ration—the amount providing 3,360 calories per day for one man for 60 days—was packed in an air resupply parachute drop kit. (Fig. 162.) The advantages of this method were: First, the calculation and measuring of the amount to eat each day was much simpler; second, one or more complete and balanced rations could be dropped immediately to a crew down in the interior from the other plane in the flight or later from a rescue plane; and third, when an extra crew member or observer was making a flight survival rations for him could be added on short notice merely by putting aboard one or more drop kits. Directions for using the rations were prepared and a copy inserted in each drop kit to supplement the briefing given on this subject. The directions were as follows:

(1) The emergency rations in R4D aircraft are packed so that each drop kit contains a balanced ration for 5 men for 12 days (or one man for 60 days). Every plane will carry as many complete ration packs as there are men aboard so that there will always be 60 days' "normal" rations for each man making the flight. As explained below, however, all men present eat from the same

ration pack at any one time, regardless of the size of the party.

(2) A break-down of the contents of each drop kit follows. Total amounts and caloric values are given in columns 2 and 3. One-sixtieth of the total amount, or the amount one man would eat per day, is given in columns 4 and 5 for each item of the list.

1 Item	Total ration		Normal daily ration for one man	
	2 No. of units	3 Calories	4 Amount	5 Calories
1. Pemmican.....	30 pkgs. (8-oz.)	40,080	1½ pkg.	668
2. Tea.....	32 bags	.....	1½ bag	
3. Powdered milk.....	7½ lbs. bulk	16,800	2 oz.	280
4. Bacon.....	2 lbs. bulk	5,856	.4 slice	97
5. Peanut butter.....	2 lbs. (net)	4,160	.5 oz	68
6. Biscuits.....	6.25-lb. can	12,000	1/60 of No.	200
7. Cocoa powder.....	1-lb. bag	1,504	1/4 oz.	25
8. Butter.....	4-lb. pkg.	14,400	1 plus oz.	240
9. Oatmeal.....	2-lb. mitt	3,648	1/2 oz. plus	60
10. Salt.....	30 1/2-oz. pkgs.	.....	1/2 pkg.	
11. Cereal blocks.....	30 2-oz. pkgs.	7,200	1/2 pkg.	120
12. Chocolate blocks.....	30 1½-oz. pkgs.	7,168	1/2 pkg.	120
13. Cocoa blocks.....	30 2-oz. pkgs.	8,700	1/2 pkg.	145
14. Sugar blocks.....	60 2½-oz. pkgs.	18,560	1 pkg.	304
15. Sugar, bulk.....	2-lb. pkg.	3,712	1/2 oz.	62
16. Cheese.....	15 4-oz. blocks	6,660	1/4 block	111
17. "Breakfast".....	30 packages	17,400	1/2 pkg.	290
18. "Dinner".....	30 packages	15,600	1/2 pkg.	260
19. "Supper".....	30 packages	18,600	1/2 pkg.	310
20. Extras: cigarettes, etc.				

(3) Additional points on the makeup of this ration:

(a) Only 32 tea bags (item No. 2) are included. However, each "Breakfast" pack (item No. 17) contains coffee powder sufficient for one cup. This will provide one cup of tea *or* coffee per day.

(b) The amount of bacon (item No. 4) allowed per man per day is given as .4 slice. This is an artificial figure resulting from the fact that there are about 24 slices in the 2 pounds included in the ration. Same applies to a few other items in column 4, such as "½ tea bag."

(c) The biscuits (item No. 6) are packed in a large tin. The average number contained in the 6¼ pounds of cookies is not known.

When the can is first opened a count of all the biscuits can be made and one-sixtieth of the total will be the average number to allow per man per day.

(d) Items 17, 18, and 19 can be recognized by their contents. The breakfast pack contains a fruit bar, biscuits, and a package of coffee powder. The dinner pack has a package of lemon powder and candy in addition to the biscuits. The supper pack contains a chocolate bar and bouillon pack besides the biscuits.

(e) Item No. 20 includes cigarettes, wooden spoons, toilet paper, etc. An early check of the numbers of each included will give an estimate of how fast they can be used up.

(f) The "normal" ration above totals about

3,360 calories per man per day for a period of 60 days. This assumes only moderate activity. For heavy work the daily caloric intake should be increased. In this case, adding half again as much of each item to the "normal" daily ration will give about 5,000 calories per man per day, and under these circumstances one complete drop kit will contain enough food for one man for about 6 weeks. In case it appears necessary to reduce rations below normal in order to extend them, one-half of the standard ration can be used as a yardstick to assist in making the decision of how much to cut. Half of the standard ration, or 1,600 calories per man per day, will probably provide subsistence if a minimum of physical activity is engaged in and if protection from the cold is fairly adequate. The ration would extend to 4 months if consumption can be kept to this level.

(4) *Menu Preparation.* (a) The amounts and caloric content of each item in the table above will serve as guides to assist in making the ration come out even. Of course, if one man were to attempt to eat from one ration kit for 60 days, he would have to estimate and measure very carefully in order to maintain an average consumption of one-sixtieth of the contents per day. However, in actual practice *only one ration is opened and used at a time.* Therefore, with an entire crew of five subsisting from one ration pack, it is finished in 12 days. As a result, portions of each item measured out daily are larger, making for easier accounting. Also an accurate check point is reached every 12 days when a ration is finished and a new one is to be opened. The rule of opening and eating from only one ration pack at a time applies regardless of the number of people in the party. !

(b) All items do not have to be served every day. Some may be eaten every second, third, or fourth day. For example, the party may prefer to eat bacon only every

other day so that a full slice is allowable, or every 4th day when there would be a credit of two slices. However, it is best to spread all items fairly evenly rather than eat preferred foods up immediately or save them until the end of the period.

(c) Sample menus for five men:

BREAKFAST

Oatmeal.....	5 oz.
Milk (powdr.).....	10 oz.
Biscuits.....	8 oz.
Butter.....	5 oz.
Sugar.....	2½ oz.
Tea.....	5 bags
Bacon.....	5 slices
(975 calories per man)	
"Breakfast".....	5 pkgs.
Coffee (from above pkg.)	
Cereal blocks.....	5 pkgs.
Milk (powdr.).....	10 oz.
(1,100 calories per man)	

DINNER

Biscuits.....	8 oz.
Chocolate blocks.....	5 blocks
Cheese.....	2½ blocks
Sugar blocks.....	5 blocks
(966 calories per man)	
"Dinner".....	5 packs
Peanut butter.....	5 oz.
Cocoa blocks.....	5 blocks
Lemon (powdr.) drink from dinner pack..	5 portions
(946 calories per man)	

SUPPER

Pemmican.....	2½ ctns, 20 oz.
Cocoa (powdr.).....	2½ oz.
Biscuit.....	8 oz.
Butter.....	5 oz.
Milk (powdr.).....	10 oz.
(1,428 calories per man)	
"Supper".....	5 packs
Bouillon (from above)	
Sugar blocks.....	5 blocks.
Cheese.....	2½ blocks
Peanut butter.....	5 oz.
(1,282 calories per man)	

(5) *Cooking suggestions.* Although some men are familiar with ordinary cooking methods, others have never prepared simple meals and to the latter these hints may prove of assistance.

(a) Never throw away bacon fat. It is high in caloric content and can be mixed

with something else and eaten. Tolerance and appreciation of fatty tasting foods usually comes with living in very cold climates, especially when exposure to cold is continuous.

(b) The monotony of biscuits can be relieved by spreading them with butter, peanut butter, or pemmican when it is prepared and ready for eating.

(c) Try to use methods which consume less fuel or require the use of the stove for shorter periods, i. e., avoid methods which require reheating, etc.

(d) Except when cooking something like bacon, have some water in the pan before putting food into it. Food burns very easily in the equipment supplied for emergency camp cooking. This applies to pemmican as well as oatmeal, etc. Stir frequently.

(e) Variety can be obtained in cooking oatmeal by adding butter, pieces of fruit bar, or biscuit. Salt makes oatmeal more palatable for most people and should be added before cooking. The usual practice is to mix oatmeal, salt, milk powder, and sugar; add the water and cook.

(f) Pemmican can be varied by the addition of fruit bar or dried fruit, extra salt, crumpled cereal block or biscuit. Small pieces of bacon can be fried in the pan before adding water and pemmican. Pemmican should be shredded first and then cooked with water to the consistency of oatmeal.

(g) Cocoa and milk powder can be mixed into one hot drink.

(h) Lemon powder and sugar can also be conveniently used in the same drink.

Note. A few of the ration packs contain dried fruit, white bread, and extra chocolate bars in place of the K-ration packs. The dried fruit can be figured at about 100 calories per ounce and the chocolate at 160 calories per ounce. The bread will have about 50 calories per slice of average thickness.

e. Briefing of R4D aircrews began on the *Philippine Sea* where Rear Admiral Byrd gave

several talks on general living conditions, geography, weather, clothing, travel, survival, etc., in the Antarctic. The principles of first aid, care of injured, and use of the medical equipment carried were thoroughly covered in discussions presented by the ship's complement medical officer. Briefings were again resumed after the aircraft arrived at the base camp. They were given by personnel with previous experience in the Antarctic, and were accompanied by demonstration of cooking pemmican, rigging a sail on a sledge, operating the cooking heater, and other practical methods of doing things with the equipment at hand. No hard and fast rules were laid down as to what to do in case of a forced landing. However, crews were advised to remain with the plane as long as practical. Matters such as when to move, area to head for, equipment to carry, etc., were left up to the plane commander for final decision. This decision to be based upon the general rescue plan, and his estimate of the situation facing the party in general and locally.

f. The Norseman (JA) airplane was operated as a general utility plane for limited photographic flights, weather reconnaissance, and contacting the trail party. It was not equipped with a heater but had outlets for electrically heated clothing. It was also equipped with litter fastenings. It was supplied for emergencies as follows:

(1) On all flights:

One first aid kit, aeronautic.

One first aid kit, life raft, camouflaged (JAN #9-217-125).

One first aid kit, pneumatic life raft (JAN #9-227-875).

(2) On all but local flights the crew chief was responsible for seeing that the following equipment was aboard:

Shovel and saw.

Four 5-gallon oil cans with funnel and 4 feet of hose.

Engine tent and cover.

- 50 feet of rope.
- Plumber's blowtorch and pot.
- One 2-gallon can of clear gasoline.
- 1 set of four "deadmen" and lines for mooring.
- 1 set of dye markers.
- 1 Coleman cook stove.
- Waterproof matches.
- One set of emergency tools.
- Corner reflector.
- One 2-man tent.

(3) On all but local flights the pilot was responsible for seeing that each man aboard had the following:

- Sleeping bag.
- 30 days' E rations.
- Skis and ski shoes.
- Five pounds of additional clothing as desired by individual or required by pilot.

2. Rescue Operation—Eastern Group.

On 30 December one of the early flights made by a PBM of the Eastern Group struck a snow covered elevation in poor visibility, exploded in air, crashed and burned near the coast at approximately 71° S. latitude and 99° W. longitude. They were found on 11 January less than 20 miles from their last reported position and about 8 to 10 miles from a stretch of open water. Emergency supplies were dropped to the party of six survivors of a crew of nine men. Only visual signals were possible. Two PBM's next flew in, one of which dropped trail markers between their position and the open water, and additional emergency supplies. The other landed on the stretch of open water and took the survivors off. A pharmacist's mate was aboard each of the two PBM's making the rescue.

a. Casualties were:

- Navigator at his position killed instantly.
- Man at radio panel killed instantly and thrown clear of plane.
- Man at flight engineer's panel thrown clear and died 2 hours later from multiple injuries.

Pilot had seat belt fastened and was rendered unconscious by striking his head against throttles. Face, hands, and legs badly burned. Removed from burning cockpit by other members of crew. His condition was critical at this time.

Co-pilot was in control of the airplane and did not have seat belt fastened. Thrown clear of plane through windshield. Dislocated and fractured right humerus. Condition serious.

Plane commander, standing in bow was thrown clear of plane. Fractured nose.

Man at flight engineer's panel without safety belt fastened was thrown clear. Suffered laceration of scalp.

Photographer in tunnel of plane was rendered semiconscious but escaped unaided with scalp laceration.

Man at radar screen thrown clear and received only superficial bruises.

b. When the plane crashed most of the medical supplies were burned. Seven days later sulfadiazine tablets and sulfanilamide powder were found. The pilot was then given sulfadiazine tablets every 4 hours. During the time the survivors stayed on the ice the pilot was kept in the fuselage. Sulfanilamide crystals were used on the lacerations. The pilot's feet were severely frostbitten, and he was evacuated on a sledge pulled by the other crewmen. Later, aboard ship his burns were found to be grossly infected and his toes gangrenous. By 18 January his condition had improved somewhat and on 27 January a report received indicated that most burned areas were healing well but that both feet were gangrenous up to 2 to 4 inches above the ankles. Several transfusions were administered and both legs were amputated below the knee, one on 31 January and the other on 4 February. Condition at this time was much improved and by 12 February wounds were reported to be healing well and he was removed from

the serious list. Both amputations were done at sea. Skin grafting as required is to be done after return to the United States.

c. Medical and other survival equipment carried aboard PBM aircraft and the extra equipment dropped to the survivors is listed below. The party was dazed for the first 2 days and did little but rest. Thereafter they searched for food and clothing, erected two tents, and prepared to wait for rescue. The crew had been wearing electrically heated flying suits over heavy underwear and summer flying suit or sweater. Two pairs of heavy socks were worn, and in addition foul weather clothing and shoe packs which were carried in the plane. Winter flying helmets and dark sun glasses were worn. Face masks were available. Fortunately much of the food was thrown clear of the airplane and was gradually recovered, enough being found to supply their needs for more than the time spent at the site of the crash. Snow was melted on the Coleman stove and in the pressure cooker.

Medical equipment carried aboard PBM aircraft

- 1 Stokes litter.
- 2 Sets splints.
- 5 Blankets.
- 4 Kits, first aid, aeronautic (JAN No. 9-196-650).
- 2 Kits, first aid, life raft (JAN No. 9-217-675).
- 3 Kits, first aid, aviator (JAN No. 9-197-675), one carried by each pilot.
- 1 Emergency first aid box containing:
 - 1 Pound roll absorbent cotton.
 - 1 Skin marking pencil.
 - 2 Tubes butyn and metaphen eye ointment.
 - 1 Eye bath with 4 oz. boric solution.
 - 4 Large battle dressings.
 - 5 Small battle dressings.
 - 1 Head dressing.
 - 1 Roll plain gauze, 25 yards.
- 18 Two-inch bandages.
- 5 Morphine syrettes.
- 10 Two. oz. bottles of brandy.
- 2 Boxes of benzedrine sulfate.
- 1 Pound boric ointment.
- 4 Four oz. tubes of boric ointment.
- 4 Rolls 2-inch adhesive tape.

- 3 Tourniquets.
- 20 Packages sulfanilamide.
- 1 Box aspirin.
- 3 Boxes iodine applicators.
- 20 Ammonia inhalers.
- 100 Cascara sagrada tablets.
- 1 Package applicators.
- 1 Book of EMT tags.
- 1 Wire splint.

Miscellaneous emergency gear carried on PBM aircraft

- 12 Immersion suits.
- 12 Sleeping bags.
- 6 Two-man tents with accessories.
- 1 Fishing kit.
- 4 Coleman stoves.
- 1 Machete.
- 1 Shovel.
- 2 Ice picks.
- 4 Pounds powdered lamp black.
- 3 Blankets.
- 20 Feet of 2-inch line.
- 12 Parachutes.
- 1 Box matches.
- 1 Rifle and ammo.
- 1 Saw.
- 1 Set extra flight clothing per man.
- 2 Seven-man rafts or 3 four-man rafts and accessories.
- 12 Mae West jackets and dye markers.
- 2 Empty cans for gasoline.
- 1 Set of cooking utensils.
- 1 Set plates and eating implements.
- 1 Arctic two-man sled.
- 12 Pairs extra gloves.
- 24 Pairs extra wool socks.
- 1 Gallons can orange paint and brush.
- 1 Gibson Girl radio.
- 360 Cans aircraft emergency tablet rations.
- 6 Boxes pemmican.
- Food for 3 days for 12 persons.

Gear dropped to survivors supplementing that found in wreckage

- 1 Coleman heater.
- 2 Cans of fuel.
- 1 Pyrotechnic projector.
- 1 Dye marker.
- 1 Box matches.
- 6 Pairs of goggles.
- 74 Cans emergency rations.
- 100 Rounds .30 cal. ammo.
- 12 Boxes large chocolate bars.
- 7 Cartons cigarettes.
- 2 Quarts whisky.

- 900 Vitamin C tablets.
 - 500 Multivitamin tablets.
 - 300 Sulfadiazine tablets.
 - 2 Wrist compasses.
 - 1 Sheath knife.
 - 1 Can emergency rations for life rafts and boats.
 - 1 Pressurer cooker.
 - 1 Bottle aspirin.
 - 1 Surgical kit.
 - 1 Rifle, .30 cal.
 - 4 Blankets.
 - 9 Pairs heavy socks.
 - 5 Face masks.
 - 9 Pairs leather mittens.
 - 9 Pairs wool mittens.
 - 9 *Suits heavy underwear.
 - 4 Rolls toilet paper.
 - 5 Gallons gasoline.
 - 1 Two-man tent.
 - 1 Pup tent.
 - 2 Shovels.
 - 100 Feet of line.
- d.* Recommendations on PBM equipment and operations made by the Eastern Group

to CTF 68 on the basis of this experience were the following:

- (1) Add two pairs of light inner socks each.
- (2) Add one shotgun, one .30 cal. carbine, and plane commander should have a .45 cal. revolver.
- (3) Each man to carry individual aid kit.
- (4) Matches and lip chap sticks should be added to first aid kits.
- (5) Black smoke signal should be devised.
- (6) Skis should be in planes or available for rescue drops.
- (7) Briefing should stress the unreliability of a snow horizon and depth perception in this area.

e. The operational plans for emergency rescue as they applied to the entire task force are discussed in section I of chapter 6. The medical support planned for the winter camp rescue party is given in paragraph 6, section II, above.

SECTION V. Recommendations

It should be emphasized that the recommendations made below are based upon the experience of Operation Highjump only. This operation was conducted under the following conditions. The area was 100 percent ice cap terrain as found on Greenland and Devon Island in the Northern Hemisphere. Temperatures ranged from freezing to 25 degrees below zero Fahrenheit with winds to approximately 45 knots. The shore-based activities involved about 200 men and officers in a temporary camp, almost all of which was sheltered under canvas. Flying was done from ice shelf surface on retractable ski landing gear. The operation was of short duration. Personnel were ashore for 5 weeks.

1. Physical Qualifications and Conditions of Troops.

a. Physical requirements for high latitude operations should be the same as present

general service standards. Decisions on personnel qualified for general service with waiver should be made on an individual basis. For flying personnel, qualifications on the standard 64 examination should suffice. The dental examination should include bitewing X-rays and periapical views of non-vital teeth on all troops destined for isolated stations.

b. Good physical condition should be maintained by a physical fitness program prior to leaving the United States, with some program continued while en route to high latitudes if a lengthy sea voyage is involved.

2. Dispensary and Medical Equipment.

It is recommended—

a. That prefabricated or Quonset type huts be used for housing medical facilities in temporary camps. The heating unit should

be planned so that it is adequate for the performance of major surgery and safe if ether anesthesia should be used.

b. That for medical support of troops in the field an inclosed, heated, tracked vehicle be developed to serve as a mobile aid station.

c. That the medical facility at cold weather bases be permanently assigned a vehicle suitable for general ambulance and flight line crash service.

d. That medical dispensaries be provided small carpenter's tool chests.

3. General Living.

It is recommended—

a. That common housekeeping items such as broom, whisk broom, shovel, pail for melting water, etc., be provided with each tent unit.

b. That bathing and laundry units be developed and provided for use whenever possible in high latitude operations.

c. That tent units be developed incorporating the requirements for cold weather use, as discussed in paragraph 1, of section III, and as recommended by participants in other cold weather operations.

4. Indoctrination and Training.

It is recommended—

a. That practical field exercises in cold weather survival be participated in by all personnel before exposure to extremely cold climates.

b. That field exercises in the use of medical equipment and employment of medical department units be stressed prior to commitment to high latitude operations. Such field exercises should be carried out in northern United States during winter months.

c. That medical department officers' cold weather training include basic instruction in navigation and emergency communications.

5. Medical Supplies.

It is recommended—

a. That duplicate items of certain essential

medical equipment be provided task forces destined for cold weather testing or operations. This is applicable to items which are breakable and where improvising of substitutes is not feasible.

b. That ointments be packed in jars and tins instead of tubes.

c. That extreme care be employed in packing equipment, marking it for identification, loading it, caching it, etc.

6. Personal Clothing and Equipment.

It is recommended—

a. That great care be taken to sizing and fitting of personal clothing and that issue of all items be made before departure from the zone of the interior. All garments should be *tried on* before issue.

b. That personnel requiring continuous use of corrective lenses be provided with dark glasses ground to their prescriptions.

7. Base Camp Messing.

It is recommended—

a. That 30 percent extra rations be provided for cold weather field operations.

b. That hot coffee, soup, etc., be made available at all times for personnel working under exposed conditions.

c. That food containers other than those made of glass be utilized to the greatest extent possible.

d. That mess and kitchens be located on the windward side of camps where snow used for making water will be less subject to contamination. The area used for a source of snow for water should be marked "off limits" to all personnel and vehicles.

8. Medical Projects for Future Study.

a. It is believed that studies of traumatic shock and its treatment under trail conditions such as might be experienced by isolated small patrol groups in cold weather should be undertaken.

b. More data are needed on solar radiation intensities under various high latitude conditions with special reference to the incidence of snow-blindness. Such a project should seek more scientific and complete knowledge of the etiology, physiology, and pathology of this condition. These studies should be directed toward the development of better eye protection methods and equipment.

c. Further studies in metabolism and caloric and vitamin requirements of troops operating in high latitudes should be carried out.

d. Studies in the prevention of freezing of medicinal liquids at low temperatures are needed. Increasing the pressure under which liquids are carried in their containers (as in ampoules) might assist materially in this regard.

9. Air Crew Personal Clothing and Equipment.

a. The development of cold weather flying clothing should be carried on with constant attention to suitability for ground survival, and types adapted to survival should generally be preferred to electrically heated clothing in its present form.

b. The amount and importance of the personal equipment and survival gear required in high latitude air operations demands that the most detailed and constant attention be given to its care. Only a personal equipment facility will fulfil this requirement. On temporary bases a Quonset type hut or large, thoroughly insulated storage tent could be utilized. Where space is at a premium the same unit could serve as a briefing, interrogation, and aircrew ready room. A unit of this type will require a full time attendant who could be responsible for checking all survival gear, rations, oxygen systems, etc., as well as flying clothing.

10. Survival and Rescue.

It is recommended—

a. That first aid training given aircrews and personnel assigned to rescue operations emphasize the emergency care and treatment of the most common types of injuries resulting from aircraft accidents.

b. That a light, man-hauling sled be developed as an item of emergency survival gear for air operations.

c. That a heating and cooking stove operating on any type of gasoline be developed or procured for assemblies of aircraft survival equipment.

d. That the survival training and indoctrination of all aircrews making extended flights at high latitudes be set up to include much more than the usual "briefings" and inspections of equipment. Practical exercises should be required in actual living and traveling with only their survival gear. Aircrews might start with their equipment strewn about at random, pack it for carrying and/or hauling, travel for a day over adverse terrain, make camp, sleep, cook meals, eat, and return the next day.

11. Air Evacuation.

The development of glider tow, landing, and snatch procedures should be continued in high latitudes with a view to advancing the effectiveness of rescue, evacuation, and resupply operations. It is recommended that the techniques of air evacuation from ice cap or similar terrain be tested, including methods of handling évacués in extremely cold climates, both aloft and in holding stations. The C-64 (Norseman) on skis appears to be better suited to evacuation from forward areas than most other standard service aircraft. The helicopter has been repeatedly suggested as the answer to the problems of rescue and evacuation. However, it is believed that the limitations of standard models now available are considerable and that de-

pendence upon helicopters should be guarded against at this time. Performance in high winds, range, and difficulties in instrument navigation leave much to be desired. Lifting capacity is another draw-back often over-

looked by nonflying personnel. The latter consideration becomes extremely important in connection with the high altitude of some areas in Alaska and the Greenland ice cap, most of which is 7,000 to 9,000 feet high.

SECTION VI. List of Medical Supplies Cached at "Little America III"

The following is a list of medical supplies inventoried and cached in the Quonset hut at "Little America III." The boxes of miscellaneous supplies were marked with yellow paint in Roman numerals.

Box I

- 2 Ether, 1/4-lb. can.
- 1 Benedict's Reagent, can q. s. 1,000 cc.
- 12 Caffeine sod. benzoate, 2-ccm. amp. (7 1/2 gr.)
- 2 Camphorated tincture of opium, pt.
- 12 Digalen, injectable, 2-cc. amp.
- 1 Pamphlet (Sanborn waterless metabolism tester).
- 1 Bag, hot water, rubber.
- 1 Merthiolate, 500-cc. bottle.
- 12 Serum albumin (100-cc. amp.).
- 1 Blood transfusion set.
- 1 Sheet wadding, cotton (32 in. by 6 yd.).
- 1 Instrument tray, flat, stainless steel, large.
- 1 Instrument tray, flat, stainless steel, small.
- 1 Wash basin, stainless steel.
- 1 Gauze container, stainless steel.

Box II

- 4 Sheet wadding, cotton (32 in. by 6 yd.).
- 16 Benzoin, compound, tincture, bottle, 4-oz.
- 2 Lanolin, can, 1 lb.
- 1 Ammonium chloride, 1-lb. bottle.
- 12 Quinine dihydrochloride, 10 cc. in amp.
- 2 Gelatin capsules No. 1, 100 in box.
- 1 Calamine, prepared, 1-lb. box.
- 25 Liver extract, amp. 1/3 unit each.
- 1 Bismuth subcarbonate, bottle.
- 3 Cod-liver oil, Stearn, pt.
- 1 Benzyl benzoate, 500-cc. bottle.
- 12 Normal human blood plasma, dried, unit.
- 1 Quinine sulfate, 1,000-tablet bottle.
- 3 Neosynephrin hydrochloride sol. 1 percent, 4 fl. oz.
- 1 Thiamine hydrochloride tablets, 50 bottles.
- 2 Carbarosone, bottle, 20 tablets.
- 12 Amyl nitrate, amp.
- 1 Fluorescine, 1-oz. bottle.
- 1 Ferrous sulfate, 0.325 gm., 100 in bottle.

Box III

This box contained streptomycin and was removed from the cache and returned to the United States.

Box IV

Same as box III; returned to the United States.

Box V

- 1 Pestle, small.
- 1 Pestle, large.
- 1 Mortar, large.
- 1 Mortar, medium.
- 1 Mortar, small.
- 4 X-ray film, 8- by 10-inch, 12 sheets.
- 5 Gauze, bandage 3-inch, 12 in box.
- 13 Gauze, bandage 2-inch, 12 in box.
- 15 Gauze, bandage, 3-inch, each.
- 18 Battle dressings, large.
- 19 Battle dressings, small.
- 16 Bal ointment, tube (eyes).
- 6 Compress bandage (head dressing).
- 13 Cotton, absorbent, 1-lb. roll.
- 1 Carbon monoxide detector, colormetric.
- 5 Carbon monoxide detectors (10 in box).
- 2 NBS indicating tubes (12 in box).

Box VI

- 1 Stand, tray, hospital, complete.
- 1 Cotton, absorbent, 1-lb. roll.
- 1 Sheet wadding, cotton 32 inches by 6 yards.

Box VII

- 12 Dextrose, 5 percent w/v in isotonic sol. sod. chloride, 1,000 cc. each.

Box VIII

- 12 Dextrose, 5 percent w/v in isotonic sol. sod. chloride, 1,000 cc. each.

Box IX

- 60 Penicillin, sodium, 200,000 units each, 10 in box.

Box X

- 2 Neoursphenamine, 0.6 gm. each, 5 amp. in box.
- 21 Oxophenarsine hydrochloride (Mapharsen) 0.6 gm. each, 10 amp. in box.
- 31 Sulfadiazine tablets, 2 gm., 2 in box.
- 2 Sodium chloride tablets, 1,000 bottle.
- 3 Cod-liver oil, 1 pt. bottle.
- 1 Ferric citrochloride, tincture, 1 pt.
- 2 Cascara sagrada, fluid extract, 1 pt.
- 1 Gum tragacanth, 1-lb. bottle.
- 5 Sulfathiazole, 7½ gr., 500 bottle.
- 1 Sulfanilamide, 5 gr., 1,000 bottle.
- 1 Sodium phosphate, 1-lb. bottle.
- 2 Dextrose anhydrous, powder, 1-lb. bottle.
- 1 Sulfosalicylic acid, bottle.
- 1 Camphor, ¼-lb. bottle.
- 3 Borax, 1-lb. box.
- 3 Sodium bicarbonate, 1-lb. box.
- 3 Boric acid powder, 1-lb. box.
- 1 Talc, purified, 1-lb. box.
- 2 Saline transfusion tablets, 100 in bottle.
- 1 Caffeine, citrated, 1-oz. bottle.
- 1 Graduate, pharmaceutical, 500 ml.
- 14 Gelatin capsules, No. 0, 100 in box.
- 7 Sulfadiazine, sodium, bottle, 5 gm.
- 2 Silver protein, strong, 1-oz. bottle.
- 2 Chalk, prepared, ½-lb. box.
- 1 Acid, salicylic, ¼-lb. box.
- 5 Tryparsamide, 3-gm. amp.
- 23 Acetylsalicylic acid powder, 1-oz. box.
- 2 Pipettes, 5 ml.
- 12 Suture, catgut, Type C, size one, tube.
- 16 Suture, catgut, Type C, size two, tube.
- 18 Acetophenetidin, 1-oz. box.
- 1 Sulfadiazine, pwd. ½ lb.
- 1 Mercurous chloride, mild, 100 tab. in bottle.
- 1 Acid, glacial acetic, 1 pt.
- 3 Test tubes.
- 2 Rectal tubes.

Box XI

- 6 Oxygen, cylinder, 80 gal. each.

Box XII

- 1 Cabinet, vision test, complete.

Box XIII

- 12 Pad, heat, chemical.
- 96 Refill, pad, heat, chemical.

Box XIV

- 72 Powder, developing, X-ray.

Box XV

- 8 Petrolatum, liquid, 1-qt. tin.

- 2 Cottonseed oil, 1-qt. tin.
- 3 Glycerin, 1-qt. tin.
- 6 Soft soap, 2-lb. jar.
- 3 Dixie cup, carton.
- 1 Sulfadiazine, gr. 7½, 500 in bottle.
- 1 Acetylsalicylic acid, grs. 5, 500 in bottle.
- 9 Magnesium sulfate, 2½-lb. box.
- 1 Acid, sulfuric, 1 pt.
- 1 Bed pan.
- 1 Tripod.
- 1 Irrigating tin, 2-qt.
- 1 Urinal.
- 2 Gauze, sterile, 25 yds., surgical.
- 2 Gauze, bandage, 3-inch, 12 in box.
- 2 Applicator sticks, carton.
- 4 Battle dressings, small, 10 in box.
- 25 Sputum cups.

Box XVI

- 126 Battle dressings, small.
- 93 Battle dressings, medium.
- 11 Pad, heat, chemical.
- 6 First aid kit, life raft.

Box XVII

- 2 Holder, X-ray film, 5 by 7, each.
- 4 Holder, X-ray film, 8 by 10, each.
- 2 Holder, X-ray film, 14 by 17 each.
- 5 Film, X-ray, 5 by 7, 12 in pkg.
- 5 Film, X-ray, 8 by 10, 12 in pkg.
- 3 Film, X-ray, 14 by 17, 12 in pkg.
- 1 Grid, radiographic, 14 by 17 each.
- 6 Aluminum hydroxide gel., 100-tablet bottle.
- 6 Gauze, plain, 36 in. by 25 yd., pkg.
- 1 Manometer, spinal, water type, each.
- 6 Insulin, injection, protamine zinc, U-40, 10-cc. bottle.
- 14 Insulin, injection, U-40, 10-cc. bottle.
- 15 Heparin, injection, 1 percent 10-cc. bottle.
- 5 Dicumarol, pulvules, 100 mgm., 100 bottle.
- 8 Foot powder, USP, 4-oz. can.
- 78 Hexavitamin capsules, 100 in bottle.

Box XVIII

- 1 Basal metabolism apparatus, 100-volt, 60-cycle, AC, each.
- 6 Chart, basal metabolism, Sanborn, 8-mc., 100 pkg.
- 10 Chart, basal metabolism, Sanborn, 9-mc., 100 pkg.
- 1 Scales, prescription, each.
- 1 Compressor, air, tankless, 100-volt, AC-DC, each.
- 1 Inhaler, mask type, oxygen-helium outfit, each.
- 6 Gauze, plain, 36 in. by 25 yd., pkg.
- 1 Syringe and needle set, local anesthesia.

SECTION VII. Comments on U. D. T. by U. S. N. Observer

Lt. Iverson (U. S. N.) Commanding Officer of the Underwater Demolition Team (U. D. T.), made the following general remarks on the tests made on the cold-water swim suits:

One activity of the underwater demolition team was to test a cold-water swim suit that was developed originally for the use of underwater demolition teams in the invasion of Japan. The suit was never used, and heretofore the underwater demolition teams were always stationed in more or less warm water ports like Southern California, along the Chesapeake, and in Florida. We had 15 men don the suit and go into the water of the Bay of Whales. The temperature of the water was 29.1° and about 2 inches of slush ice was floating. The test was limited to 20 minutes because we did not know exactly what the effects would be. The original plan was that if all the men survived the test with no ill effects, more exhaustive tests would be conducted at a later date, but unfortunately these, too, were never undertaken. Rectal temperatures, mouth temperatures, blood pressure, and respiratory rates of all the men were taken before they entered the water and after they came out and the results compared. There was a normal increase of internal temperature, blood pressure, and respiration due to exertion. The mouth temperature dropped slightly, but this of course was due to direct exposure to the cold water, as the face was not protected. None of the men had any ill effects whatsoever, the only complaint being that they failed to get circulation in their hands and feet and suffered a great deal of discomfort in these members. There

was no sudden sensation of cold, consequently there was no shivering. The cooling process was very gradual, and it was 7 to 10 minutes before any of the men felt any sort of discomfort from cold.

We tested two types of suits. One was a single piece suit which has a flap in the back for getting in and which in turn is clamped with a heavy metal clamp. The other type was a two-piece suit which depends on overlapping flaps around the torso of the body to form a watertight seal. The suits contain a hood that comes over the head and exposes only the face. They have gloves and feet made as part of the suit. Under each suit the men wore one suit of warm underwear, wool knitted gloves, and two pairs of woolen socks. The first group to wear them wore 2 suits of woolen underwear, but it was decided that this made the suit too tight and this was decreased to one so that the men might get increased circulation. The one-piece suit has a very thin felt wool lining in it, but the test was not long enough to differentiate between the two suits. Probably if the test had been carried on to the point of endurance it might have been found that the people who had on one type suit could stay in longer than the other—in 20 minutes we couldn't tell. One difficulty encountered in the suits was the fact that it was impossible to maintain a watertight seal in the face mask. The reason for this is that the suit cuts across the face below the lower lip while the face mask cuts across the upper lip, and the place where the two intercept forms an opening which allows water to come through. The air temperature at the time of the test was 26° F.

COMMUNICATIONS (SIGNAL CORPS)

SECTION I. U. S. S. Mount Olympus

1. General.

The U. S. S. *Mount Olympus*, an Amphibious Command ship in wartime, controlled all operations, assigned frequencies and call letters, relayed traffic from the base and the Eastern and Western Groups to Washington, San Francisco, Honolulu, Samoa, and New Zealand, and guarded all planes in the air.

2. Equipment.

The U. S. S. *Mount Olympus* was equipped with its standard quota of electronics equipment in accordance with BuShips Bulletin P-0-2, as follows:

a. A Communication Office where traffic despatching, decoding, and teletype facilities were located.

b. Radio I, the central receiving room, which was equipped with 50 operating positions each of which comprised an RBA (20-600 kc.) RPB (.6-4 mc.), or an RBC (4-27 mc.) receiver, a key-panel, and transmitter remote controls. Six 100-150 mc. TDQ transmitters and means for patching any antenna or transmitter to any operating position were also included. (Figs. 207, and 208, 209, and 210.

c. Radio II contained antenna selector panels for receivers, controls for transmitter and audio circuit patching, a control system for starting and stopping transmitters from Radio I, II, and III, modulators, a Western Electric FSA 850-cycle frequency shift keyer for teletype, an LR-1 Frequency Meter, two monitoring receivers (RBG HQ-129 and RBL 15-600 kc.) and the following transmitters:

(1) Two TBK's, 2-18 mc., 500-watt CW, 250-watt AM voice with MO control, plus modulator units for both.

(2) Two TBL-7's, 175-600 kc. and 2-18.1 mc., 200-watt CW or 50-watt AM voice.

(3) Three TDE's, 300 kc.—18.1 mc., 125-watt CW, 30-watt AM voice.

(4) One TAJ-18, 175-600 kc., 500-watt CW, MO controlled.

(5) One TAQ-9, 175-600 kc., 2-kw. CW only.



Figure 207. Operator's position on Mount Olympus.



Figure 208. Decoding and teletype machine.



Figure 209. Antenna system on Mount Olympus.

(6) One TBA-6, 2-26 mc., 1-kw. CW only, used normally with the frequency shift keyer for RTTY at 900 watts.

(7) Eight TCS's, 2-12 mc., 35-watt CW and 15-watt AM voice, MO or xtal con-

trolled, and powered with AC rectifiers on shipboard but with battery driven dynamotors in boats, vehicles, and other mobile operation.

d. Radio III contained transmitters and monitors to augment those in Radio II, including two TBS, 60-100 mc., AM voice intership transmitters and a TBM-7, 2-18 mc., 350-watt CW or 250-AM voice which was used for HF broadcasts during the first weeks of the expedition. A normally land-based TDH-4, 2-18 mc., 5-kw. CW, 2.5-kw. AM voice transmitter was installed here en route from Norfolk to the Antarctic to replace the TBM for broadcast work on longer hauls to New York and San Francisco.

e. The radar central, designated the Combat Information Center, was equipped with an SG, S band surface search radar, an SK, P band large air search, an SP, S band large air search, a number of repeaters, plotting boards, ABK IFF controls, and another TBS.

f. An Aerological Office incorporated radar repeaters from CIC for ballontracking and cloud observation in addition to Radiosonde Recorder.

g. The Flag Radio Room contained SCR-508's and low power AM voice equipment and was further equipped to give high ranking flag officers instant control of many circuits during landing operations. An AN/TRC-1 was located on the flying bridge for multi-channel ship-to-ship operation when required but it was not used on this expedition.

h. The ship was also equipped with a full complement of Naval RCM equipment covering all normally used radar and communication frequencies.

3. Antennas.

a. Each transmitter and receiver had its own vertical, L, or T, antenna, depending on its frequency, but folded dipoles were installed for the HF broadcast and long distance CW in two cases. Experiments with long-

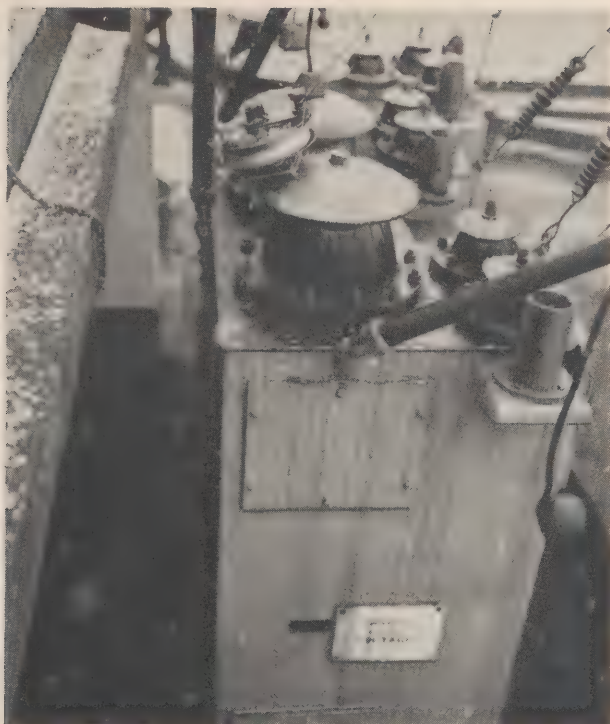


Figure 210. Antenna lead-ins on Mount Olympus.



Figure 211. Balloon antenna on Mount Olympus.

wire balloon lifted antennas (figs. 211 and 212) on 185 kc. added little to signal strength received by the East Group from the ship's folded flat-top cut for this frequency.

b. A total of 149 separate antennas including radar were counted on the ship with many of the HF vertical wire transmitting and receiving antennas parallel and so close to each other that interference on nearby frequencies was not always avoidable and RF on lead-ins of transmitters adjacent to one transmitting could sometimes be read on antenna current meters. All officers agree that a better antenna system could have been utilized for the longer distances.

4. Frequencies, Power, and Services (Ship-Ship, Ship-Plane, and Ship-States)

Ship-States frequencies assigned in the operations plan were followed closely. On leaving the States standard 500 kc. and 4, 6, 8, and 12 mc. were used until distances



Figure 212. Balloon antenna in position over Mount Olympus.

involved required higher ones. Generally speaking, 200–900 watts CW on any available transmitter, on frequencies between 8–22 mc. was employed to work Washington, San Francisco, Honolulu, and Samoa, depending on distance and light conditions.

Twenty-four hour CW contact with Washington was possible throughout except for one full day and 8 hours of another when world-wide black-out was experienced. Then and on a few other occasions, it became necessary to use the TDH on about 3 kw. CW. There was an apparent dropping of signal strength from outside when the ship entered into areas near the barrier or tied up in the Bay of Whales. Steaming out to sea to avoid the temperature gradient at the ice edge seemed to improve signals, but this can be better determined when the official Navy propagation records have been compiled. Charts will be included which will give hourly "S" readings on several frequencies throughout the 65-day stay near and south of Scott Island (67° S.). Magnetic storm and Heaviside layer reflection data were taken throughout the trip by the U. S. S. *Canisteo* and will also be included in the Navy report; usually, however, the reports on approaching magnetic conditions from the *Canisteo* after she joined the Eastern Group reached the *Mount Olympus* after the effect had been observed there.

a. Planes flying 600 miles from the U. S. S. *Philippine Sea* to Little America were in contact with the *Mount Olympus* in the Bay all the way on 6430 kc. CW and 4125 kc. voice, and followed her 2 kw. 414 kc. homing signal continually with their RDF. On another occasion two PBM's were similarly handled when they flew in to the ice-bound *Mount Olympus* in the pack ice south of Scott Island, a distance of 150 miles from their mother ship, the U. S. S. *Currituck*. On this occasion 100-150 mc. VHF equipment was used to control operations of these aircraft to a range of 35 miles and the ship's radar worked about the same distance (planes flying low).

b. The 185-kc. frequency proved unsatisfactory even with the balloon antenna, but 414 kc., the stand-by frequency in case of

HF black-out, was used for contact with both Eastern and Western Groups when their PBM's were in the air, and contacts to Samoa were frequent.

c. It is reported that low frequency (400 kc.) signals transmitted across the magnetic pole from the *Mount Olympus* to the West Group were considerably stronger than those sent at right angles to the earth's magnetic field to Samoa, an almost equal distance. This bears out previous findings on this subject.

d. Radio teletype was transmittable an average of 12 or 13 hours per day to the States, where directional antennas gave good reception. On the other hand, CW signals being transmitted on frequencies close to those used for teletype, added to the poor antenna situation, made teletype reception on the ship more difficult. It is believed, however, that a medium power station could be erected in the Antarctic which would provide good two-way teletype service 24 hours a day. It should also be added that during the period the ship was near Little America the traffic load to the States, augmented by news reports from the eleven correspondents aboard, was many times that being received, so that only south to north teletype circuits were really necessary.

e. Several broadcasts and almost daily meets were arranged with Press Wireless and RCA in New York and later San Francisco by the ABC, MBS, NBC, and CBS representatives aboard. The ship transmitted on assigned frequencies between 9 and 19 mc., using the 250-watt TBM in Radio III or the 2.5-kw. TDH and a folded dipole antenna, as conditions warranted. Cues were received on frequencies up to 24 mc., but the most used both ways for longer distances were between 17 and 22 mc. On the return trip San Francisco was contacted several times on 9-19 mc.

but the last broadcast was at Wellington, N. Z.

f. Acme radio photos (1,500-cycle shift) were transmitted on the 1 kw. TBA in Radio III an average of an hour a day throughout the trip. Washington handled this traffic at first, but it was later shifted to West Coast stations. Reception tests aboard the *Mount Olympus* were successful but no real traffic was received.

g. Considerable intership traffic was conducted on 60–100 mc. using TBS's at short distances.

h. East and West Groups maintained constant contact on frequencies between 12 and 16 mc. a maximum distance of 3,500 miles. Further information on this phase will be found in the official Navy report, since shipboard installations of vessels in these groups, the supporting oil tankers, the submarine U. S. S. *Sennett*, and the aircraft carrier U. S. S. *Philippine Sea* were normal, functioned well, and require no further comment here.

5. Landing Operations and Ship-to-Base Contacts.

During landing operations and while the ships U. S. S. *Mount Olympus*, U. S. S. *Yancey*, U. S. S. *Merrick*, U. S. S. *Northwind*, and U. S. S. *Burton Island* were tied up to the ice in the Bay of Whales low power 3265, 3965, and 4125 kc. operation was more than adequate to the base camp.

a. Shipboard SCR-608's operating with SCR-610's at the Transportation Center (the first tent camp on bay ice, distance $\frac{1}{2}$ mile from point where ships moored) and later the Airstrip Control and Emergency Base stations were heard well to 20 miles but could only receive the 610's about 3. (Fig. 213.)

b. Longer ship-shore contacts were conducted from the Scott Island and McMurdo Sound areas (700 and 400 miles) using 100–

500 watt CW on frequencies that varied from 4 to 12 mc., depending on whether all daylight or daylight to dark conditions prevailed. The aircraft frequency, 6430 kc., was used considerably for *Mount Olympus*—Emergency Base traffic when planes were not in the air.

c. Several rapid departures from the moorings on the edge of the bay ice, made necessary by adverse weather or approaching ice, brought SCR-536's into use between ships and line-handling crews on the ice with good results. Ships used standard equipment so that normal range was increased, and of course maintained contact with nearby Little America continually.

6. Radar.

Large icebergs were seen to distances of 40,000 yards (see fig. 214) but small ones, especially when their tops were flat and slanted toward the ship, were seldom seen beyond 7,000 yards. Statements in the Radar section of the Task Force Communication Plan were borne out and many small but dangerous chunks were unseen under 2,000 yards. With fog such pieces were dangerous and radar gave little protection. All other radar functions of the ship were normal, and need no comment.

7. Personnel.

a. The officers and men employed to operate shipboard equipment were drawn from the ships' complements, but those destined for work on the ice were part of the Staff. The Flag Radio Officer, trained in high power shore based stations, was assigned one chief electronics technician's mate, approximately 7 radiomen, 3 electronics technician's mates, and 4 electronics technician's mates to move ashore everything needed for the Emergency Base Station, get it transported 3 miles over the ice to Little America III, direct the construction of its building, install the equipment, and



Figure 213. First station on the ice—SCR-610's.



Figure 214. Typical Antarctic iceberg target.

then operate and maintain it. The Flag Airborne Electronics Maintenance Officer, similarly, was given an equal number of aviation electricians, radiomen, and electronics technician's mates to build, operate, and maintain the Airstrip Control Station and all airborne equipment. Later, the radio personnel of the six R4D plane crews augmented this number.

b. Standard policies for naval instruction produce trained operators and technicians

who are well versed in code, procedure, operation, and the maintenance of individual radio equipments. However, specialists completely familiar with noise elimination methods, antenna fabrication and direction, and general shore station installation and operation under varying conditions would be exceedingly valuable on an operation of this type.

8. Briefing.

Briefing lectures which covered everything from survival to elementary meteorology and geology were presented daily by experts between Panama and Antarctica. Clothing and how to wear it in cold weather, navigation, nature study, self protection, foods, transportation methods, communications, and a number of other subjects helped prepare staff, ship's officers, observers, and crew for the coming ordeal. It is impossible to tell how many accidents or mishaps this briefing avoided, but everyone voluntarily turned out for every lecture and no serious errors were forthcoming. It cannot be emphasized too strongly that any man who is to be a communication officer or even operator under cold weather conditions, whether out on some remote trail party or not, must be primarily versed in how to take care of himself and his equipment under adverse weather conditions, and then secondly have a good knowledge of first aid, navigation, food preparation, and vehicles. In addition, even though an officer or man is not a communication man, he must have a solid working knowledge of the radio equipment his party is using to protect his life. In combat, the knowledge necessary for fighting must supplement the above.

SECTION II. Airstrip Control Station

1. General.

a. Installation of the operating room (fig. 215), the repair facilities (figs. 216, 217, and 218), and spare parts shelves (fig. 219) began as soon as walls and roof had been completed.

b. The station itself went through three major phases. At first it was a radio supply

dump and repair shop and utilized only SCR-610's for intercamp and shore-to-ship contacts with other such units in the Transportation Center, Headquarters, two Weasels, and SCR-608's on the ships. Then a group started operations at the Emergency Base 2 miles to the south at Little America III,



Figure 215. Operating position in base air operations tent at base airstrip.



Figure 216. Repair facilities in base operations at airstrip.



Figure 217. Alinement bench in base operations.



Figure 218. Radar repair in base air operations.



Figure 219. Spare parts section in Quonset hut.



Figure 220. Antennas.

whereupon Transportation Traffic Control and Camp, ship, Emergency Base Command circuits became necessary. SCR-610's were now augmented by SCR-694's, SCR-536's and low power MHF shipboard sets operating on 4125 and 3965 kc. Later, as rapidly as equipment became available, higher power was installed so that by the time the R4D's were ready to take off from the U. S. S. *Philippine Sea* on 30 January sets were in operation as described in the paragraphs which follow.

2. MHF Long Distance Transmitters, Receivers, and Noise.

a. Two ART-13's (ATC) Collins 100 watt, 0.2-1.5 and 2-18 mc. airborne transmitters were powered by dynamotors driven by 24-volt storage batteries which floated across a charging line. One of these was tuned to 4125 kc., the primary aircraft frequency, except when, with its low frequency tuning unit, it was required for 414-kc. operation with ships or planes. The other remained tuned to 6430 kc., the secondary aircraft frequency, throughout the month on the ice. (Fig. 220.)

(1) When flights began early in February the noise level at airstrip was so high that the expected long distance contacts on 4125 and even 6430 kc. were difficult. Emergency Base therefore, with its higher power and better antennas, was required to handle long distance plane-to-ground traffic until the noise levels at airstrip had been somewhat relieved. Even then 6430 kc. remained in use as the long distance CW frequency, and 4125 kc. was used largely on short distance voice circuits from that point on.

(2) This second ART-13 worked well and continuously after the noise reduction and had little trouble with the farthest planes (800 miles) or the ships when they proceeded to Scott Island in mid-February (600 miles).

(3) It should also be pointed out that 6430 kc. was seldom used for ship-shore traffic except when the planes were on the ground, although on some occasions traffic loads from Emergency Base to Airstrip became so large, because weather reports from all three groups of ships were being relayed through the *Mount Olympus*, that this set and frequency were used to reduce them. (Communications to the R4D's flying in from the *Philippine Sea* were handled entirely by the *Mount Olympus* in the Bay as stated before.)

(4) In summing up, it can be said that more power and carefully cut and directed

antennas would have been welcome on many occasions, and the audible and electrical noise of the dynamotors of these transmitters was a distinct and continuing handicap to the operators of nearby receivers.

b. Two BC-348 dynamotor-operated receivers were first installed for use with the transmitters described above on 28 January, and on 1 February they were found so quiet with a short wire antenna laid on the snow that an operator was able to indentify 40 R-9 14-megacycle amateur stations in the New York area in an hour. Several equipment changes were made in the next few days, however, including the erection of 30-foot-high long wire antennas, and on 5, 6, and 7 February noise levels were so high that only two stations could be heard in the entire amateur band.

(1) The storage batteries driving the dynamotors of both transmitters and receivers had been swung across a 28-volt DC generator, automatic camera timing devices were being tested on the same circuit, and power units had been started nearby, including another battery-charging plant behind the Quonset. All of this was "grounded" to a common counterpoise consisting of the metal building, several radial wires under the snow, the two 160-foot wires of the TBW counterpoise system, and the 500-foot-long grid of the 400-watt 414-kc. YR homing device, *with* the ground posts of all receivers and transmitters in the station. Since this maze was isolated from the sea beneath by approximately 200 feet of perfectly insulating snow it could only act as an antenna for additional noise pickup and a direct means of transferring all interference, normally grounded out by high capacity to ground, from all transmitters and noise generators in operation to the sensitive receiver antenna circuits.

(2) In all events, the BC-348's were suspected, although later proven innocent,

and replaced by AC powered RBC-2's and RBM-1's. The slight decrease in noise level afforded by this change was believed by the writer to be due to a lack of sensitivity in the latter rather than from the elimination of noise generated by the well filtered dynamotor circuits in the BC-348's, but this was never proven.

(3) Adequate line noise filters were not available due to a lack of large condensers and heavy wire and only the installation of AC chargers in place of the DC generator on the battery power line reduced the noise level appreciably. It still remained high throughout.

3. MHF Low Power.

a. One TCS 30-watt CW 15-watt AM voice, 2-12 mc. transmitter-receiver unit was installed beside and one slightly above the ART-13's just described. These operated from dynamotors driven by the same batteries and charging system as those above, and both transmitters and receivers had their ground posts tied into the same counterpoise network, as well as the shields of the 25-foot coaxial cables whose central wires fed their comparatively high-impedance whips (15 feet at 4 mc.). Noise levels, caused by key clicks and dynamotor hash from the nearby and directly connected ART-13's and other transmitters allowed only strong signals to be heard.

b. These sets operated to the ships when in or just outside the Bay (15 miles maximum), the Emergency Base (2 miles) for relaying large amounts of traffic when the *Mount Olympus* had gone to Scott Island, the GPN unit $\frac{1}{2}$ mile distant for intercom on flight control, the LVT's when they proceeded eastward on their trail trip (see section V), the JA Norseman (60 miles maximum), the small OY (L-5) (15 miles with difficulty), and the R4D's when in range (about 15 miles on voice). Voice was used in all cases until distances became

too great, whereupon the ART-13's were called upon to carry on with CW.

c. A frequency of 3265 kc. was used for contact with the GPN and the Emergency Base relay circuit on one unit and 4125 or 3965 kc. on the other to ships or planes, but these were alternated as need arose.

d. Noise elimination and better antenna design would have greatly improved the behavior of this equipment, as shown by the perfect reception obtained by the 134-mile distant LVT where no noise was present and a carefully cut dipole was pointed at the airstrip. TCS's are considered excellent for mobile use where some shelter from weather is available.

4. VHF.

a. An ARC-1, 100-150 mc. VHF AM voice transmitter-receiver of about 15 watts' output was operated mostly on 142.02 mc. for airstrip control of planes. This was ineffective to planes more than 30 miles distant because of its fabricated antenna, yet a similar unit at the GPN equipped with a quarter wave antenna with a 45° downward tilted ground plane worked satisfactorily an average of 40 miles.

b. No further VHF propagation tests were made other than those between planes, described in section III.

5. L. F.

A TBW 100-watt CW or AM voice, 0.2-18 mc. transmitter with its RBM-4 receivers was also installed at the airstrip for use on low frequencies as a homing station or on medium highs as an auxiliary. Its antenna for low frequencies consisted of two horizontal wires spaced 6 feet apart stretched 160 feet from the edge of the Quonset northwestward to a 40-foot sectionalized steel mast. A single wire between these formed the MHF antenna. Below all three a two-wire counterpoise also spread 6 feet was hung between Quonset and mast about 6 feet above the snow and this

was tied into the common counterpoise system described above.

a. This unit was powered by a 110-220 AC motor which drove a 12-volt DC-110-volt 400-cycle AC generator and this in turn fed the transformer of the transmitter. An auxiliary gas-engine-driven 12-volt DC-110-volt 400-cycle AC generator was also available (see fig. 221).

b. The unit was unheard on low frequencies when listened for by the ships at sea but on 414 and 538 kc. as an auxiliary to the YR homing stations it was heard by planes an average of 30 to 50 miles. It was always on standby for MHF but was never needed for this purpose.

6. SCR-610's.

All SCR-610's were eventually removed from the airstrip station except one on 38.4 mc. which remained in operation with the first-aid Weasel or "crash truck", the "ready" tent, and the Transportation Center until the camp was demobilized. The Weasel and the tent used standard whip antennas but the airstrip unit was equipped with a coupling unit, a 25-foot coaxial cable and a 4-section MP-48, MS-54, 53, 52 whip erected 6 feet above the roof. Distance was approximately 3 miles maximum.

a. These sets, and the SCR-536's were the only ones ever used outdoors, but temperatures did not fall below -25° F. so little information can be added to that already published in S. C. E. L.'s "Operation of Signal Corps Equipment at Low Temperatures."

b. Altogether about 30 second-hand SCR-610's were acquired by Task Force 68 and of these only about 15 were used. Storage batteries and vibrator packs were used exclusively and batteries resting on cold tent or building floors presented a constant charging and replacement problem. Voltages were usually low after but a few hours

intermittent use, since until late February battery charging facilities and means of delivery from the central unit were limited. "C" batteries were dated 1944 and lost voltage rapidly even at $+18^{\circ}$ F., the average temperature encountered. No facilities for heating them were available.

c. Units carefully lined up on the ship or in the Quonset with warm batteries, both storage and dry, were found off frequency and inoperable when installed in tents a few hours later with other storage batteries (low voltage, no doubt). Others which had cooled 50° outdoors since line-up were off because of bias changes. So many things had to be handled by a minimum of technicians, most of whom had had little previous experience with this type of equipment, but the set developed into a definite bottleneck. It was replaced by TCS's on intercamp circuits by 10 February, but it nevertheless played a definite part in expedition communications. The units which operated throughout the stay on the ice, namely those in the airstrip, Weasel, and "ready" tent, proved that this set could be made to work without frequent adjustment if fed with good batteries. Operators were in only a few cases technicians, so that when a set failed to get contact it was hours before



Figure 221. TBW power supply.

some normally easy battery charge or other adjustment could be made.

d. It seems clear, from this experience and others in the past, that sets for widespread use in areas where variable ground and low temperature conditions exist must be designed so that the operator can easily bring or keep his equipment on frequency. Multi-stage units which shift frequency with battery voltage or temperature and then require accurate line-up by a skilled operator are definitely not for the use of harassed line officers or truck drivers at points remotely placed from a service station, and particularly so when batteries on tent floors remain at 0° F. or lower while sets 2 feet higher vary in temperature from 0° to 70° F. with nearby stove adjustments throughout the day. Antennas pushed through drift-tight holes in tent roofs covered with melting snow to the floor are not conducive to optimum operation either. Some type of insulating or isolating sleeve should be devised for this purpose.

e. It should also be stated here that excellent results were obtained with quickly fabricated centerfed dipole antennas. Those used two $\frac{1}{4}$ -wavelengths of wire separated by an insulator in the center and were fed with standard 50-ohm coaxial cable of which the pigtailed braid and center wire were led to the outer ends of the insulator. The set end of the coax was connected to the antenna coupling unit in the normal way, and both ends were sealed against moisture. Three of these tipped at an 80-degree angle from the snow with their upper ends fastened to the metal Quonset hut roof with porcelain line spreads, loaded easily, gave a good degree of vertical polarization for the distant vertical whips, required no counterpoises, and so were free from direct interference, and provided favorable signal strength reports when compared to whips at the same location. Since omni-directional patterns in the vicin-

ity of a station equipped with many masts, wires, and other metal objects are impossible to obtain, the effect of the feed cable coming off at one side was negligible.

f. The transmitter-oscillator tube of SCR-610 required considerable replacement.

7. SCR-536's.

When several of the 30 SCR-536's taken ashore at Little America had been put on frequency (3965, 4125, and 3265 kc.) and used for point-to-point and ice-to-ship communications, statements that, "Those won't work a mile," or, "My Handy-Talky's no good, I can't get 500 yards with it," and many similar remarks were heard. Two new units were carefully lined up on 5500 kc. with new batteries (all dated 1944) and an operational test was initiated as follows: Starting from a heated tent on the thick ice the writer skied away from it in a straight line, calling every hundred yards. One set was still warm in the tent and the temperature outside was -15° F. At 400 yards, with the wind blowing by the wearer's windproof hood at 15 m. p. h., the signal was barely audible. With the hood off and the moistureproof cover removed from the earphone the signal could just be understood at 500 yards. It was unheard at 600 until the lack of ground was remembered, whereupon by removing gloves and clasping the set with bare hands a faint signal could be distinguished. However, after a delay of one-half hour to enable the batteries to cool, this signal disappeared; yet, on return, the tent set reported good signals all the way. The sets were warmed up and changed and the test made again with the same results. The sets were then warmed again and both taken outdoors, whereupon after one-half hour's time communication across the level high barrier ice was just possible at 500 yards with sets in gloved hands. Glove removal to provide direct counterpoise helped some, but

little, and frequency change to 3200 kc. brought no change.

a. Both horizontal and vertical polarizations of antennas (both ends) were tried with vertical proving best, no doubt because of the general vertical characteristics of the operator's "body counterpoise."

b. Several times throughout the stay on the ice attempts were made to contact the ships on 4125 kc. $1\frac{3}{4}$ miles distant with only one doubtful contact resulting. Batteries and line-up were good at all times, this frequency was carefully guarded, and the ship had much higher power and better antennas. (Fig. 222.)

c. One fair contact $\frac{1}{2}$ mile from the barrier top to the ship and several hours' operation over the same distance but with the user standing on only 3-foot thick ice over seawater were successful, but many attempts to call the SCR-694 at camp from the trail 2 miles out toward Emergency Base failed completely when the operator of the SCR-694 expected the call, but $\frac{1}{2}$ -mile contacts to this set were common.

d. To sum up, Radio Sets SCR-536 equipped with outdated batteries, which nevertheless read 1.45 and 92 volts when warmed after use and 1.48 and 95 before, appear to be unsatisfactory for distances of more than 500 yards to each other over level thick snow (200 feet) when held in gloved hands. On the other hand, many days' valuable usage was obtained from this set when used at $\frac{1}{2}$ mile distances from a central SCR-694 or low power shipboard installation. The duration of any communication will depend on temperatures and resultant battery voltages, as is already known.

8. Radio Set SCR-694, Sleds, Antennas, and Hand Generators.

Four SCR-694's were taken on the expedition equipped with PE-237's and Hand Generators GN-58. During the trip from



Figure 222. Use of SCR-536 did not prove too successful for ship-to-shore or close-in communications, due to outdated batteries, etc.

Norfolk to Panama cold weather operation of GN-58 was discussed and it was decided to procure GN-35's from Panama and rewire them to fit the cabling of the SCR-694's. The writer¹ obtained six of the last few units in the Panama depot, but the wiring was postponed until actual cold weather operation was required. This was never done, but the GN-58's were winterized in advance.

a. At sea in the South Pacific, dog-team drivers were briefed on this set and during a test call when using the hand generator a very satisfactory contact was made with another expedition ship 300 miles distant. The distant ship used regular ship's gear.

b. Upon arrival at the ice, and the first week thereafter, one set was the principal means of communication from camp to ships. It worked very well until, after 60 hours, the mercury vapor rectifier failed in the PE-257, causing intermittent transmission. All trouble disappeared with replacement and no other trouble developed. Since this set operated in warmed tents no cold weather

¹ Mr. Amory H. Waite.

information can be added to that already known.

c. A second unit was carried on the U. S. M. C. LVT trail trip as an emergency set. Placed on the forward end of the sled, army, 1-ton, it traveled behind an LVT over rough sastrugi for 245 miles in its canvas cases, tied in among sundry other items. Upon return it was found that the canvas covers of the BC-1306 and the GN-58 had leaked and both were full of the fine powdery drift snow of the Antarctic. None had gotten inside the set whose metal cover had been left off, or the generator, however, and no real damage would have resulted from this since all personnel are trained to brush dry snow away from equipment before it can melt. The 1L4 in the receiver and the transmitter oscillator tube had been damaged by vibration and the set would have been found inoperative if it had been needed. Replacement of these made the set operate perfectly as it had before the trip started.

d. This brings up a serious question relative to cold weather travel. All shock mounts have been designed for satisfactory operation when firmly fastened in place, but have no value if a set *with* its shock-mounted base plates can be banged around as in this case. Furthermore, study of all types of tractor drawn cargo sleds over a period of many years has shown that short sleds, such as the 1-ton and similar ones used on hundreds of miles of trail trips in 1934-1935, always give their cargoes a terrific pounding on rough snow, and particularly that loaded on the nose.

(1) It is also true that the heavier portions of a sled load must be carried well back over the strong bridges to keep the sled from breaking up (400-lb. oil drums, etc.), thus pushing light elements forward. On high, wide reaches of thick snow (200 to 5,000 feet thick) wind ridges or sastrugi vary in height from one to several feet, in length from a few feet to

hundreds of yards, and in spacing from 2 feet to several yards.

(2) On long trips over this type of country, therefore, sled noses inevitably rise over, and pound down into, ridge after ridge for mile after mile. Gas cans break, box boards come loose, bags wear through and the items on the nose of the sled, and the nose itself, take the worst punishment. Each jerk from starting or stopping adds to this. The many sleds used around Little America on this expedition probably will be reported as showing few signs of wear and tear after their comparatively smooth trips from ships to camp over worn trails, since the only trips over wide open snow were the trail trip mentioned above and short 10-mile runs from camp to Little America II. *But*, the writer rode the sled on one of the latter and took a worse licking in 10 miles at 10 m. p. h. behind a Weasel than he had in 800 miles in 1934 behind a 1½-knot tractor. Therefore, it should be definitely stated that if personnel or fragile electronic gear is to be carried on long trips over rough snow behind comparatively high speed vehicles they must either ride on a longer or more smoothly riding sled than the Army, 1-ton, and be cushioned adequately, or suffer considerable damage. (See fig. 223.)

e. The SCR-694 referred to in this case was set up on its return, serviced, and operated in a warm tent after a thorough warm-up. It was then taken outdoors at +10° F. for 3 hours and tried again. The GN-58, even with light oil, was prohibitively difficult to turn, yet in 1935 GN-35's were used satisfactorily in temperatures of 60 and 70 degrees below zero. Conditions in terrain of this type are such that even though two operators may be assigned to a radio set, one to crank and one to operate, only one may be available at times while the other sleeps or cares for other routine matters. Thus, the man on duty must crank and send

simultaneously and to do this must have a hand generator which turns so easily while he is keying or talking that he does not need to concentrate on it. The writer did this on hundreds of contacts over a period of many years in both warm and cold weather with GN-35's, though even that unit turns hard when loaded. This was attested by Admiral Byrd during his isolation in 1934 when operation of his set became impossible because of his weakened condition and contact was lost for days. Therefore, in view of the fact that sets such as the GRC-9 or SCR-694, which can provide communication under severe temperature conditions, need a power source which is devoid of *all* batteries, dry or wet, in many circumstances, it is indicated that a hand generator capable of being easily turned with one hand is essential.

f. When noise conditions at the Airstrip Control Station were very bad and exploratory planes were being received with difficulty the writer drew a third SCR-694 from supply and connected it up in his tent for monitoring purposes. A half-wave antenna (for 6430 kc.) was then erected on 10-foot wooden poles and pointed for maximum signal from the trail party. (Laid on snow with equal results.)

(1) During the next few days the trail party was heard S-5 on all monitored schedules when Airstrip reported him S-3. San Francisco broadcasts on 6 mc. were heard all over the tent with earphones for hours every night and KFS (San Francisco) and WSL (New York) press were copied nightly with ease. The noise level was very low and augmented only intermittently by the ignition of a PE-214 some 30 feet away, and occasional unsuppressed caterpillars as they passed.

(2) The antenna was then swung to get maximum signals from the ships 600 miles away and again S-5 signals were received.



Figure 223. Weasel towing Army QM 1-ton sled.

In fact the signal from the *Mount Olympus* was almost as loud as that from Airstrip 500 yards away.

g. Planes were monitored throughout all the longer flights and on almost every occasion were loud and clear when operators at Airstrip failed to hear calls or were asking for repeats (because of noise conditions).

h. Finally, permission was requested to transmit on the same frequency (6430 kc.) on an attempt to ask the U. S. S. *Burton Island*, which was approaching the Bay of Whales (about 70 miles away), for a signal strength report. This was granted and the call NLA-2 issued (Airstrip was NLA-1 and Emergency Base was NLA). At 1:00 a. m. on 22 February 1947, the writer, with his antenna pointed at New York, 80° away from the ships, waited till the net was clear and called T6L8 with the understanding that that call, which was Admiral Cruzen's own, had moved from the *Mount Olympus* to the *Burton Island* when she started southward with him aboard. Immediate answer was received from a regulation call-up, i. e., "T6L8 T6L8 V NLA-2 INT QSA," with a QSA-3 report, when Airstrip using 100 watts had been given QSA-4 but a few moments previously. After two more brief exchanges

the writer signed off with NLA and NLA-1 and stopped operation, but the next day it was discovered that T6L8 was still on the *Mount Olympus* 600 miles away. Reception was perfect. Thus, the experiences of earlier Byrd expedition radio engineers were borne out, namely, that a low power transmitter with a quiet receiver can communicate long distances in the quiet Polar regions (5 watts to two tube battery receiver daylight to daylight on 7 mc. 500 miles constantly for 2 months, except for short periods of snow static, in 1935). Nevertheless, it must be remembered, as was learned by experience and put to good use in 1935 and again in 1939, that on high snow, counterpoises are not grounds but antennas completely isolated from ground. Completely individual antenna-counterpoise systems thus become necessary for *each* transmitter-receiver combination that is to operate satisfactorily in proximity to others and noise generators must not connect to any radiating system or counterpoise.

9. Power Units

No troubles were observed with any power unit used at Little America that might not have occurred in the Temperate Zone in winter. The following facts are listed.

a. The DC supply of Airstrip Control consisted of an Onan gas-engine generator model JWC4-10S-3 which supplied 127/220-volt 60-cycle 3-phase current to a G. E. motor-generator which delivered as much as 200 amperes at 28 volts DC to the batteries and shop maintenance work.. (See fig. 224.) the Onan generator had a capacity of 10 kw. at unity PF and the 3-phase motor of M-G set drew 29 amperes at 220 volts. It was located in a separate shelter behind the Quonset. The DC power lines and generator radiated high level noise to receiver antenna systems as did the Onan

generator. Later, this Onan generator was moved 150 feet away to the YR hut (to be described later) and connected to a 120-volt single-phase unit which thenceforth supplied the entire Quonset with AC. Thus, the TCS's could be put on AC directly, the ART's on 28-volt batteries charged by AC driven chargers with the ARC-1, and AC receivers were used throughout. (The TBW described above caused a little noise but was seldom operated.) This change, coupled with the replacement of small gas engine driven battery chargers, which had also been near the station, with AC rectifiers for all battery charging, eliminated a lot of noise.

(1) A week's supply of fuel was always kept on hand in case blizzards made it hard to get to the fuel dump. Condensation in gas lines caused trouble as did spark plugs. At -20° F. the Onan ran erratically and stopped on two occasions. When plugs were cleaned it was heated with a Herman and started satisfactorily (perhaps moisture in gas line).

(2) One man was kept busy continually changing oil every 24 hours and filling gas tanks. Larger tanks are essential and power units should be on skis or have runners available for their wheels for this terrain. The Onan was changed from 70- to 100-octane gas for the last week on the ice and failed 20 minutes before the camp was evacuated, cause unknown. Oil was standard SAE No. 10, and appeared very dirty after 24 hours' running. All equipment was left behind except strictly classified items.

b. PE-99 (one of two drawn from Panama when it was learned that PE-75's were going to be used for 3 kw. loads, no PE-95's available) which powered the YR homing station had to be heated to make it start at -25° F. Its oil gage had to be heated with a blowtorch in cold weather, and fuel strainers clogged frequently. This was due

to sediment in the gasoline supply, and indicated a need for prefiltering as was always done in 1935. Otherwise this unit ran satisfactorily when needed (when planes were in the air within range of 70 miles) except for one broken brush-holder.

Shelters are essential for all power units which are to operate in areas where fine snow is blown about in periods of high wind.

c. A PE-75 supplied lighting and 120-volt 60-cycle AC to the hut during the period before the Onan was connected to the AC generator. It used 70-octane gas, SAE No. 10 oil, and ran satisfactorily throughout, as did all others observed. Nevertheless, both generator and ignition were sources of noise.

d. Four re-built wartime Jeeps were equipped by the Navy prior to departure from Norfolk with 300-ampere 28-volt DC generators coupled to their transmissions. Two had 350-watt 110-volt 60-cycle generators also but this function was not used; however, they were used to charge storage batteries rapidly in planes and other locations. The generators were satisfactory throughout but the well-worn engines failed on several occasions. The generator-Jeep's greatest drawback was the fact that they had to be dragged by tractor through the deep snow and ruts around the planes which was undesirable. With new engines and with skis available for their wheels to permit mobility these units might prove valuable on an operation of this type.

e. Two heavy duty power units alternately supplied the camp mess hall with light and power. One or the other of these ran continually without trouble throughout the stay on the ice. (See fig. 225 and ch. 3 for details.)

f. Two PE-214's were brought to Little America by Mr. Taylor of NRL for powering his sound attenuation measuring equipment. One or the other of these was in operation from 8:00 a. m. to midnight every day for 20 days without failure. They started easily

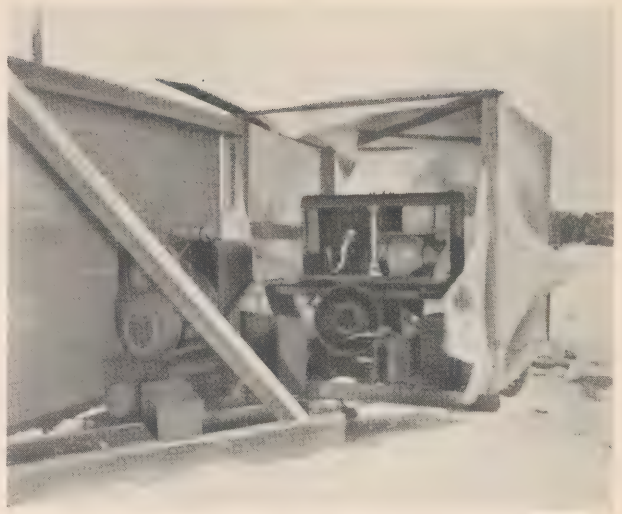


Figure 224. Onan generator.



Figure 225. Camp lighting supply.

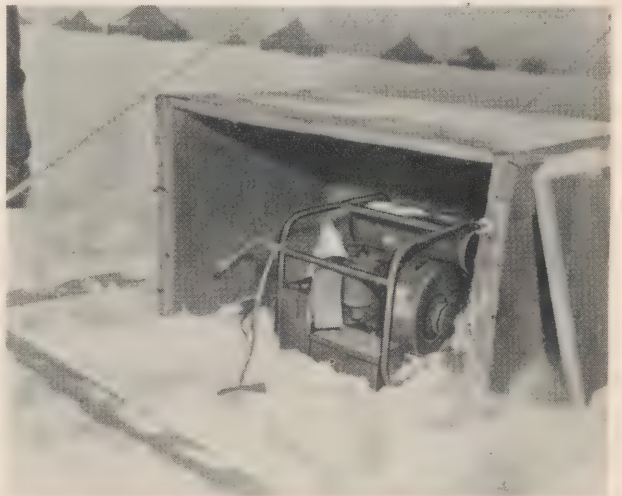


Figure 226. PE-214 in snow shed.

at -20°F . but at temperatures below -10°F . were slightly erratic. They were taken out of service when a line from the mess hall generator became available because well regulated current was a necessity. Without grounds available they radiated considerable noise (see fig. 226).

g. When the 4 Jeeps mentioned in *d* above proved difficult to move, several Homelight HRU-28-A gas-engine driven 28-volt DC generators were mounted on sleds and hand-pulled to planes and other locations for battery-charging. These proved to be exceedingly handy devices.

h. Storage batteries were a constant problem in regard to charging, care, and delivery to the outlying radio sets in the camp. One of the 14-man teams at Airstrip, described in paragraph 7*a*, section I, did nothing but charge and replace run-down batteries. Following previous examples and information in SCEL's, "Operation of SC Equipment at Low Temperatures", gravity was raised above normal and only two units froze. These were in aircraft which on some of the longer flights had fuselage temperatures drop to -30°F . (See par. 5, sec. VII.)

i. Dry cells acted as expected under all conditions. As stated above all batteries for SCR-610's and SCR-536's were outdated and lost output rapidly when exposed to cold. The BA-48's (only six available for the operation) for the SCR-694's worked exceedingly well. One operated the receiver in a tent for about 4 hours a day for a week and then when taken outdoors for 2 hours at $+5^{\circ}\text{F}$. showed only slight decrease in signal strength. Warm (60°F .) voltage at the time was 86 and 1.45. Three were carefully packed for future observation, the one mentioned above, a new unused one and the one which was returned from the tractor trip. This had a broken case from the pounding it received but it had not lost voltage. Both new ones were normal when left.

10. Navigational Aids, YR Homing Beacon.

The navigational aids to the exploratory planes consisted of the GPN, the YR homing device, the Meteorology and Aerology Group, and the auxiliary TBW in the Airstrip Quonset hut. A ground control approach system (GCA) was carried to the Antarctic with the understanding that it would be returned upon the expedition's homecoming. It, therefore, was not put in operation since before being installed completely it had to be loaded aboard the ships which were sailing to safe locations beyond the menacing ice pack. The unit provided some interesting lessons in trans-snow transport, however. Figure 228 shows how it required two caterpillar tractors to tow it in the soft snow with difficulty (one ski broke loose), the details of the ski used, and the drift that formed around it in a few days' time. The heavy power unit also presented a serious problem when being pulled up the barrier slope. Obviously, good ski or sled equipment is needed for this unit when it is to be used in snow-covered areas.

Both power unit engines were damaged by the freezing of cooling water which had remained in them since their last period of operation. This strongly dictates a policy of careful inspection of all water cooled engines before being shipped from the United States and again before being put ashore from a warm ship's hold in cold weather.

a. GPN. The GPN semimobile air search and ground control radar is covered in detail in the official Navy report. It was dragged into position at the edge of the airstrip about 500 yards east of Airstrip Control with considerable difficulty. It then was assembled rapidly, went into operation whenever a plane was in the air within range, and followed all planes successfully to its 30-mile limit. Its ARC-1, 100-150 mc. unit also worked well as stated above,

as did its TCS. (Fig. 229 shows it in operation.) The crew lived in a tent nearby, where another TCS and long wire antenna were installed so that they could be alerted from Airstrip Control when needed.

b. *UPN/4*. A distance test was made with Racon *UPN/4* to determine its usefulness in the Antarctic. This unit is an X-band portable radar beacon which is triggered by a distant plane when required. It operated satisfactorily for 1 hour on one flight to a distance of approximately 30 miles. It is understood this unit is classified and it was not used again.

c. *YR*. The nondirectional Radio Telephone Beacon (type H) Navy Model YR is a 200–800 kc. crystal controlled 25–400 watt homing device which automatically transmits a 1020 cycle identification signal of 1, 2, or 3 letters. It is normally equipped with a T type antenna at least 50 feet high in which the equal side portions of the T provide capacity top-loading and because they are equal do not affect the omnidirectivity of the vertical wire.

(1) This unit was installed in a shack 150 feet behind the Quonset hut at Airstrip Control. (See fig. 230.) It was powered by one phase of the 3-phase PE-99 generator, 110 volts, 60 cycles, 2.6 kva. Unfortunately, the only poles available raised its antenna less than 35 feet above the snow and thus reduced its range. With no ground available, first a single wire counterpoise, then a grid and then a combination of all counterpoises at Airstrip Control were tried. Since the latter combination would seriously affect the circular signal pattern, with the steel Quonset tied in, the idea was not approved by all. Nevertheless, the MO signal on 414 or 538 kc. was heard by planes to 100 miles on some occasions and used for homing an average of 60 miles on most flights. This signal caused considerable interference in the control station because of its proximity, lack

of ground, and the directed connection to the common counterpoise. In future, all such units should be isolated as far as possible from communication receivers, be provided with a large balanced counterpoise of wire grid or perhaps Marston matting, and an antenna at least 50 feet high as specified. The 2kw 414 RC signal from the *Mount Olympus* in the Bay was followed all the way from Scott Island (600 miles) to the Bay of Whales, but on the 800-mile South Pole flight no homing signals were available except the YR, since the ships were at Scott Island. This was of comparatively little value at more than 50 miles, and the auxiliary TBW less than that.

(2) During the YR's installation it was found that proper crystals were not available, so a 6SJ7 oscillator was constructed that worked adequately. All remote control units were in the YR shack since no 3-wire control cable was available for the 150-foot run to the operations control room. The MO signals were found to be too slow for the ADJ equipment in the planes to give a steady signal, requiring about 6 seconds for each complete MO. This was remedied by putting two MO signals on the code disc by filing down unused dots and using these for



Figure 227. GCA front wheel runner.

spaces between characters and groups. A continuous series of 2-second MO's with $\frac{1}{2}$ -second intervals was thus achieved. Some trouble was had with contacts of relay K-303

sticking, but cleaning relieved this and no further defect was noted.

d. No other radar devices or electronic navigational aids were used but all pilots and navigators continually voiced a desire for radio ranges and homing devices with a range of at least 200 miles. One pilot stated that a YG would have been invaluable on some of the 25 flights made, and others recommended that Loran stations should be installed as a definite aid to accuracy and aerial navigation.

11. Meteorology.

Constant weather information was relayed to Little America from the ships and the East and West Groups to aid aerial navigation. The LVT trail party to the Rockefeller Mountains also helped in this



Figure 228. GCA stuck again.



Figure 229. GPN in operation located at edge of airstrip.

respect, but reports from this group were usually so late because of radio schedule times that they were of little value. Planes flying inland in search of full weather information sometimes found weather in the interior suitable for long flights when conditions on the coast were poor. Observations from pilots of such flights materially aided the aerology section established at the airstrip. (See fig. 231.) Full details of this subject will be found in chapter 11. No automatic weather stations were utilized, and no radar balloon-tracking was attempted on the ice.

12. Camp Interphone System, Telephones.

Surprisingly, no type of unit-to-unit, office-to-office, or intercommunication system was used at Little America IV. The camp with its airfield facilities, transportation center, supply system, ready rooms, and staff tents was spread out over almost a square mile of territory. Walking from point to point or requisitioning a Weasel for a half mile run to obtain information from individuals wasted much time. Even SCR-536's did not fill the bill. One or two 12-drop boards, a couple of dozen EE-8 telephones,

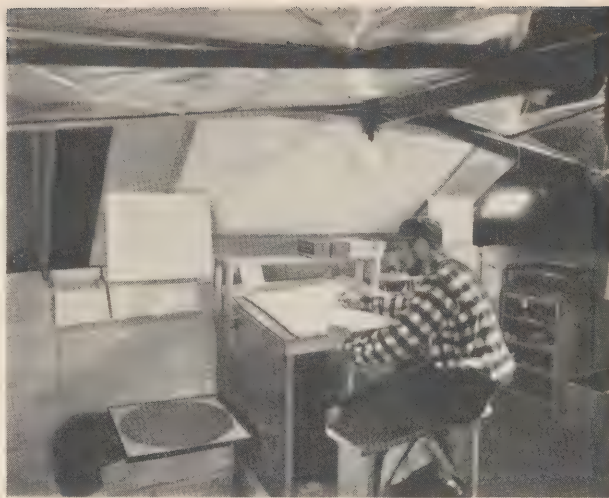


Figure 231. Plotting the weather in meteorology tent.

and a few miles of W-110-B wire would have been invaluable. Much travel, time, and radio transmission could also have been saved by laying a 2-mile line to Emergency Base. The writer has had considerable experience with field telephone systems and feels certain that the task of installing an adequate system could have been accomplished with ease. Wire could have been strung from tent to tent with few additional supports, entrenched under thorofares or laid on the snow on long runs easily and safely. Nothing was observed on this expedition or in 1935 that leads one to believe that field wire would not serve adequately and durably.

13. Air-Sea Rescue, Casualties, Landing Operations.

No rescue operations were required by the Central Group, fortunately, and those necessary when the PBM crashed and was lost for several days in the eastern area were conducted entirely from the air without help from radio in the hands of the downed fliers. It is reported that a small radio set was dropped to the group after they were sighted, but that it did not operate satisfactorily. Facts can be determined only



Figure 230. YR installation from Quonset hut. Note power lines and supplies.

when the report of the Eastern Group has been compiled. Nevertheless, much discussion of what would happen in case one of the R4D's at Little America was downed in a remote area, was heard. Depending on distance from base, planes, Weasels, and/or dog teams would have been used. Plane search radar was to be established by means of plane sets or SCR-694's in Weasels or on dog teams. If feasible, SCR-536's or SCR-694's could also have been dropped had the communications of the crashed ship been put out of commission.

a. Here again AN/GRC-9's with easily turnable hand generators would have been ideal for crew and search parties alike, since such an operation would perhaps have taken weeks, depending on distance and accessibility of the location, and batteries for reliable, long period operation on the trail in cold weather are out of the question. Full details of proposed rescue plans are included in chapter 6. Nevertheless, it is felt that search radar in planes looking for lost groups, and an intercommunication system between ships, boats, planes, ground vehicles including dog teams, and the downed parties composed of installed equipment on ships and planes, and AN/GRC-9's in boat and ground parties, would provide a usable system. Frequencies would, of course, be 4-6 mc. assigned aircraft frequencies, with the higher one favored for distances over 25 or 30 miles in daylight if voice signals were to be used with whip antennas. All dog teams and vehicles should be equipped to spread $\frac{1}{2}$ wave antennas on the snow when not in motion, and CW operators are a necessity. In addition, all search party receivers must be capable of short period

standby operation (BA-48-BC-1306 when battery is kept warm or light multi-cell leak-proof storage-battery filled to 1360 sp. g.) and be able to receive 8 mc. signals from Gibson Girl transmitters. Light, portable DF equipment would be essential if planes carrying that type of equipment were not available.

b. In combat, obviously, all rescue communications and measures would depend on the strategic situation. The Weasel has proven itself beyond doubt a valuable tool on the Antarctic snow, but its durability is still in question. It is believed all officers of this expedition would agree that they would hesitate to use a *single* vehicle in its present design for trips of more than a few miles from any base.

c. For removing casualties, the equipment described above would be adequate for longer distances, and that of the SCR-508, SCR-608 type for vehicles traveling short distances would be preferred, but again this would depend on the situation from a distance and frequency availability viewpoint.

d. Landing operations in territories similar to the Antarctic could be carried out as they would anywhere else as long as adequate winterization and camouflage measures are observed. Equipment must be on tracks or skis and communication units must have their own vehicles at all times to maintain mobility. Furthermore, because of the ever present possibility of small separated groups being cut off from supply lines for days by blizzards, each such group must be self-supporting as to fuel, food, shelter, clothing, ammunition, and medical equipment. Failure to observe this precaution will cost more lives than enemy bullets.

SECTION III. Aircraft

1. Airplanes Available.

Task Force 68 used six R4D's for major exploratory flights at Little America and PBM's in the Eastern and Western Groups. These were augmented by SOC's, HOS and HO3S helicopters, a JA Norseman (C-64), and 2 OY's (L-5). Each plane carried Navy standard equipment for its particular type which functioned satisfactorily, but since the writer was stationed at Little America only planes observed there will be discussed. It should be pointed out, however, that helicopters though somewhat limited in range served invaluable in making ice pack reconnaissances from ice breakers. No task or amphibious force should be without them in future when operating in high latitudes. The six R4D's flew in from the U. S. S. *Philippine Sea* on 30 January. The JA was brought down and landed by the *Mount Olympus*. The 2 OY's, one of which was never assembled, came down by means of the *Philippine Sea* and the U. S. S. *Northwind* (from Scott Island rendezvous). The electronic equipment used and results obtained are discussed in the following paragraphs.

2. R4D Equipment, Frequencies, and Operation.

The electronic equipment installation in the R4D's (C-47's) was standard.

a. AN/ARC-1 transceivers, 10 channels VHF available, 142.02 used most, distance averaged from plane-to-airstrip 24 miles, plane-to-plane on voice up to 100 miles, command.

b. AN/ARC-5 transmitters and receivers, 15 watt MHF set, used between planes on command circuits on voice, distance 60 miles, usual frequency 4125 kc.

c. AN/ART-13 transmitter with BC-348 receiver, 100 watts MHF and LF with

special tuning unit, used for air-ground and plane-to-plane long distance work and kept on 6430 kc. throughout with rare exceptions on 414 kc. for tests. Voice up to 150 miles between planes, and sometimes up to 500 to ground with 800 miles on CW.

d. Each plane carried 2 AN/ARN-7 Radio Compasses, an AN/ARR-2 Homing Adapter, and an AN/ARN-8 Marker Beacon Receiver. All functioned without defect when satisfactory signals were supplied from ground, ships, or planes.

e. Each plane also utilized its AN/AIA-2A Interphone and Radio System and was equipped with a General Electric wire recorder (see section VII).

f. Radio Altimeters AN/APN-1 and SCR-718B were carried and worked normally, as did the AN/APS-4 Aircraft Radar Search and AN/APX-2A Aircraft IFF Equipment. Unfortunately no radar mapping was done in the Central Group due to a lack of equipment and personnel but this subject is covered by Mr. Robert Davis of the Strategic Air Command whose specialty it was.

g. The Operations Plan specified that the SCR-718 altimeter be photographed once each minute of flight. To this end, a Recording Camera, Type ABLE, was attached to each SCR-718 installation. All discussion of aerial trimetrogon photography and mapping will be included in the Navy report in detail. PBM's of the Eastern and Western Groups are reported to have used radar for some mapping.

h. Prior to departure from Norfolk, Virginia, it was foreseen that anti-precipitation antennas would be needed on the R4D's to counteract the static developed by snowstorms and other similar disturbances. New compass sense, marker beacon, and flat-top antennas (for liaison and MHF command circuits) were constructed using parts of

antenna assembly kit AS-211/AR. All joints in antenna wire WS-S/U were taped with a special dielectric tape (Polythylene) manufactured by the Minnesota Mining Company. All joints were painted daily with flake shellac mixed with grain alcohol to provide strength and further corona resistance all the time the U. S. S. *Philippine Sea* was underway. Each antenna was repeatedly tested and insulated to resist 40,000 volts generated by a high-frequency, high voltage megger. A total of $\frac{1}{4}$ -inch of shellac thus accumulated on the joints by the time the planes were ready for take-off on the Antarctic flight and all antennas proved very satisfactory as regards static pick-up on all flights. Insulation removal was accomplished with a hot soldering iron instead of with a knife with excellent results. No wires were nicked and none broke later because of nicks.

i. The aircraft installation was made further corona-resistant by installation of static dischargers AN/ASA-31. Twelve were used on each plane, 3 on the trailing edge of each wing, 2 on the trailing edge of each horizontal stabilizer, and 2 on the trailing edge of the vertical fin. Only one 4- or 5-hour period (on 6430 kc.) of heavy atmospheric noise was reported.

3. JA (Norseman).

The JA Norseman flew constantly on reconnaissance flights around Little America to distances of 70 miles and communication was always satisfactory. Equipment used was the standard installation of ARC-5 and TCS on the 4125 and 6430 kc. frequencies throughout.

4. OY.

The one OY assembled flew more often than any other plane and proved invaluable

for short distance work, since it could land almost anywhere without a prepared landing field. It was equipped with an ARC-5 which had considerable trouble maintaining contact with Airstrip Control more than 10 miles on 3265 kc. voice. This was mostly due to the transmitting antenna on the TCS at Airstrip which was used to contact this plane and the prevalent noise level at the same point. The TCS at GPN proved more satisfactory, since it had both a better antenna and a quieter location. The shortness of the plane's antenna at the frequency used was also partly to blame, but since 15 miles was the limit to which the plane was allowed to fly the communication available was adequate.

5. Maintenance.

A complete electronic maintenance and repair station was installed in the airstrip Quonset before flights began. This was well equipped with signal generators, wave guides, 20 different types of test sets, oscillators, analyzers, and frequency meters and, under the direct supervision of the airborne electronics maintenance officer, handled the minor problems presented efficiently at all times.

6. Conclusions.

To sum up, communications in all planes assigned to the Central Group were adequate, particularly when the noise had been somewhat reduced at the ground station, personnel were better trained and equipment was remarkably free from need for repairs other than routine checking and storage battery charging. No defect has been reported that was directly traceable to operation in cold weather other than the two frozen storage batteries described above.

SECTION IV. Emergency Base Station

1. Site.

A so-called "Emergency Base Station" was established in a double Quonset hut (assembled end to end) which was constructed above the 1939-1941 buildings of Little America III. (See fig. 160.) Its purpose was to provide adequate Antarctic and Stateside communication and shelter for a then undetermined force throughout the following winter had it become necessary to leave search parties behind to rescue some downed plane crew. Fortunately, no planes were forced down and the station was abandoned when the expedition sailed on 24 February.

2. Equipment.

After the Quonsets had been completed the station was well installed by the electronics officer and his staff. It contained a 500-watt TBM 2-18.1 mc., 350-watt MCW-V, with a special TBA tuning unit for matching rhombic antennas, a TBL 175 kc.-2 mc. and 2-18 mc., 50-watt voice, 100-watt



Figure 233. Quonset hut at Emergency Base (Little America III), showing radio operators at rear of hut.



Figure 232. Quonset hut at Emergency Base (Little America III). Note transmitter unit in background.

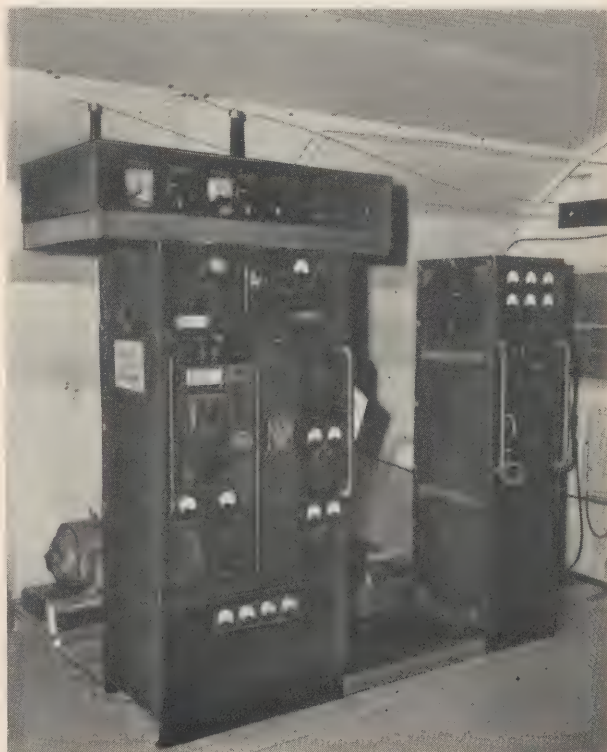


Figure 234. TBM and TBA tuning unit and modulator.

MCW, 200-watt CW and TCS transmitters and a series of RBA, RBB, and RBC receivers which covered all frequencies from



Figure 235. Emergency Base (Little America III) receiving positions.



Figure 236. GM 25-kva. power unit.

175 kc. to 18 mc. (See figs. 232, 233, 234 and 235.) Here all transmitting facilities were segregated in one end of the building and remotely controlled from the receiving positions at the other end. All intercabling was done in cable troughs along the walls to keep noise at a minimum and the 3-phase AC power unit placed outside the transmitter end away from the receivers also aided in this respect. The Navy also had a new MAW, 100-156 mc. portable set at this location though it was confidential and little used. One of its features was a small leak-proof storage battery which provided all power.

3. Traffic Handled.

Well constructed T and L type antennas with good counterpoises, coupled with higher power and lower existent noise level permitted this station to handle traffic with distant planes and ships with ease when the Airstrip Control Station was swamped in heavy noise. A major portion of Olympus-Base and Base-to-distant-plane traffic was therefore cleared by this station until the noise reduction was effected at Airstrip late in February. Relaying from Emergency



Figure 237. Antennas and lead-ins at Emergency Base (Little America III).

Base to Airstrip was done by messenger or on TCS's using voice on 3265 kc. or similar MHF frequencies. SCR-508's for this 2-mile jump would have been helpful but were not available; SCR-610's were not satisfactory as explained above.

4. Power

All power was obtained from a 25-kva, 220-volt, 3-phase, 60-cycle Diesel engine-driven GM generator which was installed in a special ventilated shelter away from the main building (see fig. 236). This had all the transmitters connected on one phase, all receivers on another, and lighting and various auxiliary power on the third. A 3-phase motor-driven motor-generator set supplied 1000, 2000, and 3000 volts DC to the TBM as well as providing 300 volts of bias.

5. Bonding

All units were again bonded to a common counterpoise, as was the metal shell of the building, and RF on intercom leads was often evident.

6. Antennas

Two standard Army rhombic antennas 350 feet long on each leg were erected on 40-foot telephone poles and pointed at Washington ($78^{\circ} 14'$), side by side. One transmitted and one received. These, with the 500-watt CW TBM later permitted 2 days of satisfactory testing with Washington on 4-12 mc. frequencies, and it is believed 24-hour contact with any overseas States' station could easily have been established with this equipment (see fig. 237) with proper choice of frequencies.

7. Storage Prior to Departure.

When the time for departure arrived all but the classified electronic equipment at Little America was stored in the Quonset hut at Emergency Base with considerable supplies of food and clothing. Further information relative to the station's operation are included in section I, since this unit tied in so closely with those of the U. S. S. *Mount Olympus*.

SECTION V. Trail Party

1. Equipment and Frequencies Used.

The only radio equipped trail party consisted of two U. S. M. C. LVT's and a crew of seven military personnel which traveled to a point 134 miles from Little America and stayed out only 7 days (see fig. 238). An LVT-4, the command vehicle, was equipped with an SCR-608 and a storage-battery powered TCS. The LVT-3 had only the SCR-608 for intercommunication. It was anticipated that the TCS 15-watt voice transmitter on 4125 kcs. would provide communications satisfactorily to the 300-mile distant objective originally planned for, but this signal proved unusable beyond 22 miles



Figure 238. Radio and interior installations in LVT-4.

with the normal vehicular whip antenna. A change to 6430 kc. 30-watt CW operation with a $\frac{1}{2}$ wave dipole antenna (designed by the writer) spread $\frac{1}{4}$ wave each side of the vehicle on short poles resulted in more than adequate signals throughout the trip. Complicated aircraft communication schedules at



Figure 239. SCR-694 in living tent.



Figure 240. GN-58.

the Airstrip Station somewhat upset the trail party's scheduled plans but the operator had little difficulty contacting the base on the aircraft frequency used (6430 kc.) whenever required (when planes not in the air). Obviously, separate vehicular nets would be advisable on operations where more than a few vehicles are involved, but under the circumstances the vehicles were secondary to plane flights and necessary contact was maintained. Weather reports, which were one of the primary missions of the group, were delayed because schedules could be kept only at intervals, and thus lost much value. The party was called in for this reason and because the completion of all flights and the departure of the expedition were imminent.

2. Performance of Equipment.

The SCR-608's, which operated satisfactorily when the group left camp, remained in operation for only the first few miles of the trip when one unit failed. These were not put back in operation throughout the trip since the vehicles had to remain close to each other because of the always present danger of crevasses, and thus were always in visual contact. Besides, conditions are such on a trip of this nature that all hands are continually occupied on matters which are vital to general operation and personal



Figure 241. SCR-694.

existence, to the point where even the time necessary for the radioman to locate and replace a defective vacuum tube cannot be spared unless the equipment involved is essential. In all events, this equipment was never repaired since the expedition departed shortly after the return of the trail trip and vehicles and sets were left behind.

3. Range Tests.

The writer had counted on obtaining considerable information pertinent to the

distances obtainable with equipment in the frequency and power range of SCR-608's over snow during the return trip of the tractors, when separation was possible because crevasse positions had been noted, but the rapid return ordered canceled the only opportunity. No SCR-608's were available at Little America for tests on the outward journey. The SCR-694 carried on the nose of the 1-ton cargo sled as an emergency unit is discussed in paragraph 8, section II. (See figs. 239, 240, and 241.)

SECTION VI. Clothing

1. General.

Clothing worn on the ice in the Antarctic generally consisted of combinations of Army winter uniforms and Navy foul weather gear.

2. Conditions Encountered.

No particular hardships were experienced by radio personnel on this expedition but had they been called upon to spend the winter at Little America on outdoor combat operations the clothing and tentage available would have been inadequate. One interesting case of a radio operator in a plane suffering from anoxia is described in paragraph 7j (4) (b) of section II, chapter 7.

3. Gloves.

A special glove must be designed which will allow an operator to manipulate dials and telegraph keys and splice wire in low temperatures, of such a nature that it can be worn under other warmer gloves or mittens for long period exposure. Silk gloves have been found satisfactory for some tasks but the inclination of the individual is to remove all gloves for brief repair or tuning jobs and in real cold this will result in flesh sticking

to metal and hands freezing with a general slow-up of all operations concerned.

4. Uniform.

a. From considerable cold weather experience the writer forms the definite opinion that temperatures in all shelters must be kept low except in dressing and eating quarters so that the individual can always choose his basic costume for the cold outside while not having to remove more than one heavy layer of snow- and wind-proof garment when entering buildings. He thus is not too warm inside or too cold outside with the extra layer. The writer was not uncomfortable at outside temperatures to -25° F. when wearing one suit of heavy underwear, a Byrd-cloth undershirt, a woolen sweater, and standard GI uniforms except when tent temperatures were boosted well over 70° F. Two pairs of woolen socks and inner soles inside canvas mukluks were satisfactory for the feet as long as drying facilities were available at the end of the day. One or two pairs of woolen mittens covered with leather shells allowed the hands to remain warm. The standard Army ski cap needed a woolen helmet under

it on the colder days but was adequate most of the time.

b. Over the above costume a suit of thin plane-fabric windproof was worn on all snowy or wind-drifty days and this was bolstered with the alpaca liner in extreme cold. Obviously, on long, cold trips or continuous exposure without occasional access to warm buildings, additional clothing must be worn. This subject is discussed more fully in

the joint report. It will always be a hardship to line up accurately a piece of electronic equipment outdoors in cold weather. It takes longer and personnel become careless of their adjustments because of an eagerness to get gloves on again. Knobs for cold weather equipment should be kept as large as possible so that they can be adjusted with mittens and small gadgets requiring extra tools should be eliminated.

SECTION VII. Observations

1. An electronic magnetometer, AN/ASQ-3A, brought to the Antarctic by geologist James Balsley of the U. S. Geological Survey for purposes of locating possible magnetic mineral deposits from aircraft proved highly satisfactory for also determining the position and composition of sub-snow terrain. This device, given but a brief try-out on a few of the later flights, promises considerable aid to previously used mapping facilities and should be carefully studied by the Army if such action has not already been undertaken. The current instruction book is CO-AN-08-20-14 published by the Navy Department 1 June 1944. Figure 242 shows the device set up for test prior to flight at Little America.

a. A similar instrument was set up on the ground by representatives of NOL for the purpose of making measurements of the earth's magnetic field in synchronization with a second station in Alaska, but results have so far not been correlated.

b. The writer has been privately interested for many years in means of locating metals buried under ground, snow, and water, using home-made equipment. Also interested in matters concerning the Antarctic, he personally loaned his equipment to the

United States Antarctic Service Expedition of 1939-1941 for locating buried air-bottles gas drums, vehicles, and other metallic objects left behind by previous expeditions. This proved exceedingly useful to depths of 3 or 4 feet. Another such device was therefore taken on Operation Highjump, after being modified to work at greater depths, to help in locating tractors and gasoline caches left behind in 1935 and 1939, respectively. Brief tests on bay ice indicated that the modified unit was an improvement, but unfortunately it was badly damaged by a Weasel before it could be put to use. Nevertheless, discussion of metal-finding equipment with the magnetometer team revealed that a lightweight, portable magnetometer, which should find magnetic objects the size of a jeep to depths of 30 feet in snow, is now under development by the Navy. Such an item should prove valuable to any force operating in deep snow areas where semipermanent bases might remain occupied long enough to allow equipment to be drifted over. Many articles were lost in this way on Operation Highjump in spite of precautions taken to mark supply piles during blizzards, during one of which snow drifted 4 feet deep in a single night. (See fig. 243.)



Figure 242. The magnetometer being tested prior to flight.

c. Another interesting fact relative to the lack of electrical grounds on thick névé or glacial ice was furnished by the NOL magnetometer team when they reported that sensitive galvanometers were always knocked off scale by operators' touching insulated adjustment knobs on the equipment. Apparently static charges are picked up by human bodies in the cold, dry air and/or from the snow surface, and study of means for eliminating this type of static should be undertaken by anyone contemplating careful electrical measurements under similar conditions. Bonding and the wearing of gloves helped but did not completely relieve this situation.

2. A high degree of "singing" in tightly stretched wires was observed on several occasions when no wind was blowing. This phenomenon, which was only noticed in cases

where the wire was iron- or steel-cored "Copperweld", may have been due to the high concentration of the earth's flux so close to the magnetic pole. Ten-foot wires were audible at several feet, and poles supporting 300-foot long rhombic antenna wires could be heard harmonizing at several yards. Singing wires may or may not be a hazard under combat conditions but it is believed the situation should be mentioned. The same phenomena was observed continually through the Antarctic winter of 1934 by the writer and several other persons, but no definite explanation has yet been achieved.

3. NRL physicists were equipped with complete equipment for measuring the attenuation of sound waves through various types of Antarctic ice, and careful preparations for an extended series of measurements were made. Nevertheless, only a single evening was dedicated to actually measuring samples. Several ice samples were cut from the walls of a 16-foot deep shaft in the snow, placed between the geophones (fig. 244) and subjected to a pulsed 30-kc. signal. The signal from the receiving geophone was then amplified and passed to a scope which measured the elapsed time between transmission and



Figure 243. Metal locator.



Figure 244. Sound attenuation measuring equipment.

reception of the signal on an electronically calibrated base line. Results can be obtained from Mr. A. H. Taylor of NRL, who is preparing a paper on the subject. Strength, hardness, and compressibility measurements of ice and snow were made by Navy engineers in conjunction with Major J. H. Holcombe, Army Engineer Observer, and information obtained will be found in chapter 3.

4. Fabricated galvanized steel masts installed at Little America I in 1929 were still in excellent condition after 18 years, but although the three-bladed propeller of the Wincharger wind-driven generator on top of one of them was still turning, black-painted portions had rusted so badly from the melting caused by heat absorption that the rudder could not be engaged and electrical output measured. This may indicate that non-heat-absorbent paints will be necessary for Signal Corps equipment which is to be used in high

latitudes, as well as to resist radiation wave scorching by nuclear explosives as witnessed at Bikini.

a. Forty-foot telephone poles erected in 1934 still showed 18 feet of their length above the snow surface after 12 years of drift and only slight weathering was apparent. Insulators and steel guy cables were undamaged.

b. Eight feet of the originally 30-foot long bamboo rhombic antenna poles erected at Little America III in 1939 were still visible above the surface. Some insulators, which had been taped to the pole tops, had blown away, but many were still in place with their attached wires. Long spans of wire (No. 14 Copperweld) had sagged sufficiently to drift over in the middle portions during the 6-year period of inattention, but both wire and insulators could have been used again.

5. No equipment which could have been classed as "electronic" was found at either Little America III or II, but a few frozen and burst storage batteries at Little America III, dry batteries at both camps, light bulbs, wiring and one radio tube were observed. It is unfortunate that the radio shack and battery room of the 1934-35 Byrd Expedition could not have been excavated, since storage batteries there had had their full charge gravity raised to 1360 and had been reported unbroken in 1939. It would have been interesting indeed to have compared these with the dozen or more found at Little America III whose gravity had been left at 1300 in 1939. All of the latter had burst from freezing and electrolyte stains surrounded them on the floor. The writer wishes to add that after several years' close contact with lead-acid batteries before 1934, he watched completely discharged batteries remain *unfrozen* on field trips in the winter of that year at temperatures down to 84° below zero F. throughout a 2-month period. Their gravity had been carefully raised to 1360 before departure from the warm battery room at Little America II contrary to currently

existent instructions. This bears out in practice, with the further evidence of two frozen storage batteries seen during Operation Highjump where temperatures only fell below -25° F. in planes, the statements included in SCEL's "Operation of SC Equipment in Low Temperatures."

6. Several samples of flashlight cells and higher voltage blocks found in both camps, which still gave normal voltage readings when thawed out, are being returned to SCEL for study. All have passed through at least six winters and summers where temperatures varied from 0° to -70° F. and some are 15 years old. Forty-five volt blocks, left under the snow by the 1930 Byrd Expedition, were thawed out in 1934 and tested in comparison with new batteries of the same make and size. Slow discharge runs on several pairs showed the units which had been frozen for 4 years had considerable more milliamperes-hour capacity than the new ones. Whether this was due to a decrease in quality of production

throughout the intervening period has not been determined.

7. General Electric Company Wire Recorder and Reproducer, Model 51, and Recorder-Reproducer VRW-1, developed by Brush for the Navy Department, were used throughout the expedition to a surprising degree. So many conferences, verbal reports, orders, broadcast programs, and other on-the-spot information was retained for subsequent transcription, that these devices became an important factor in the task of recording many phases of Operation Highjump. Neither, in its present form, meets Signal Corps requirements for field use but either could be made to do so, if this has not already been done.

8. Geomagnetic measurements were carried on by representatives of the U. S. Coast and Geodetic Survey for several weeks relative to the frequency and magnitude of magnetic storms. All information obtained can be procured from that organization when it has been correlated.

SECTION VIII. Recommendations

1. General.

a. Communications throughout the expedition were adequate and well handled, but certain problems arose which should be studied with a view toward complete rectification or elimination of difficulties for future cold weather operation. These are listed in the order of their importance as follows:

(1) Lack of electrical grounds and the ineffectiveness of counterpoises on thick snow or ice.

(2) Noise levels traceable to ungrounded noise producers such as DC generators, sup-

pressed or unsuppressed vehicles and power units, and unfiltered electrical equipment.

(3) A lack of personnel who had been trained in cold weather operation of shore stations, where antenna design, direction, and matching, and a knowledge of how to choose frequencies and powers are extremely helpful.

(4) Too few or inadequate aids to aerial navigation, including homing devices, GCA, and radio ranges.

b. After careful consideration of all information available from Operation Highjump and the 1933-1935 Second Byrd

Antarctic Expedition the recommendations in the following paragraphs are made in the hope that they will aid in preparing for similar operations in future, and particularly so should such an effort be undertaken by the Army.

2. Packaged Radio Sets.

It is recommended that packaged AC powered radio sets (such as SCR-399 or MRC-2) be used for ground station installations on thick snow or ice in which all components are ready for operation immediately upon reaching location. Such units with properly designed antennas should accomplish any communication necessary—and can be easily transported and adequately heated.

3. Antennas.

a. Whenever ground stations are to be operated on thick snow or ice no more than one transmitter and one receiver should be connected to any one antenna and counterpoise system. Thus, additional antennas for other frequencies or directions can be switched at will, and additional transmitter-receiver units, if needed, can be added to provide more channels provided the antenna system of each is isolated by a few feet of snow or ice.

b. All MHF portable or vehicular sets should be provided with center-fed (balanced) dipole antennas which can be quickly flung out on the snow or short poles $\frac{1}{4}$ wave either side of a vehicle when not in motion.

c. Antennas should be placed on thick snow surfaces instead of on poles or masts whenever surface traffic and a multiplicity of antennas do not preclude this, since the snow appears to be an efficient insulator.

d. The feasibility of drilling holes for conductors or sinking conductors in thick snow areas to permit the lower halves of vertical

dipole antennas to be installed therein should be studied. Propagation of sets operating above 6 mc. could be thus considerably improved since directors and reflectors could also be easily added and the wide resulting lobe be useful, particularly at airfields where one station or homing device is required to cover large sectors.

4. Transmitting Facilities.

All transmitting facilities, including homing devices and navigational aids, should be isolated from any receiving position in large multi-circuit stations in which more than three or four packaged units are required.

5. Generators.

a. All DC battery charging generators should be eliminated and replaced with AC generators and AC rectifiers.

b. A hand generator should be semi-portable, designed for trail and rescue work in high latitudes with sets similar to SCR-694 or AN/GRC-9 which can be easily turned with one hand when cold. (See par. 8, sec. II.

c. It is recommended that a study be made of the need for procurement by the Signal Corps of the 300-ampere, 28-volt DC generator-Jeeps devised by the Navy.

6. Noise Reduction.

a. All power units and vehicles should be studied as to their noise producing characteristics when suspended more than 50 feet above the ground, both through radiation and conduction through power lines.

b. All noise producing devices which are intended for use near a receiving station, on thick snow where even counterpoises are antennas, should be isolated as much as possible, bonded to a common point, and have filters made available for use in their output circuits to receivers, or batteries driving receivers, which are adequate.

c. The fundamentals of noise elimination should be taught in Signal Corps schools if this is not already done. If it is, emphasis should be placed on it for personnel intended for service in cold weather and/or thick snow areas.

7. Cold Weather Operation of Radio Sets.

a. Any radio set for use outside a heated shelter, portable or otherwise, in areas where low temperatures prevail, should be designed in such a way that its operator can readily return it to optimum operation as regards frequency drift from voltage changes or temperature variation.

b. All equipment for operation in cold weather should be installed in vehicles or shelters where heat is available except hand-carried short period sets such as SCR-536's. If all radio sets can be installed in warmed vehicles, or shelters on vehicles, it is strongly believed the subsequent results will be greatly improved. Outdoor operation is not conducive to careful manipulation, keying, writing, or the stability and functioning of the apparatus itself.

c. Hard to aline, multi-stage sets such as the SCR-610 which contain dry batteries should not be used in field operations in cold weather.

8. Batteries.

All lead-acid storage batteries should be filled with 1360 specific gravity electrolyte before being put ashore in cold areas, and again reduced to normal upon return to temperate zones.

9. Propagation Tests.

a. Extensive propagation tests should be carried out to determine the reflection, blocking, or damping effects of thick snow as a transmission medium and its characteristics at various depths should be determined from the viewpoint of designing adequate

noise eliminating counterpoises through capacity to lower ice strata, earth, or sea beneath.

b. It is recommended that no effort be wasted in attempts to drill or otherwise form holes through thick snow for grounds or counterpoise capacities to sea water or earth beneath until propagation characteristics of the medium have been determined as recommended above.

c. The official Navy report on Operation Highjump should be obtained upon its completion so that propagation and Heaviside layer studies in the Antarctic may be made available to all concerned.

10. Transportation of Equipment.

a. Any electronic equipment which is to be transported long distances as cargo on sleds should be secured either on piles of resilient material in the middle of the sled or should be provided with shockproof and snowproof containers, particularly if short sleds such as Army, 1-ton, are to be used.

b. A plan for properly unloading electronic equipment from ships, transporting it, and placing it in caches or supply dumps should be studied, and suitable instructions prepared for cold weather areas.

11. Intracamp Communication.

It is recommended that an intracamp telephone system be utilized.

12. Power Units.

All power units should be sheltered to prevent them from filling with fine snow during periods of drift, and this should also include the canvas covers of some sets which are not now snowproof.

13. Grounds.

The conception of the difficulties of operation where grounds are not available should be taught to all potential Signal Corps operational personnel.

14. Navigation Aids.

It is recommended that high power homing devices, radio ranges, and similar equipment be provided for aerial navigation and that personnel be taught how to counteract difficulties in their operation brought about by operation on thick snow or ice or in low temperatures.

15. Aircraft Communication.

At all communication installations *all* traffic should be kept off aircraft frequencies except air-ground traffic itself.

16. Training of Personnel.

All personnel for subsequent service in cold weather areas should be given strong instruction in self-preservation first, and then secondarily in the pursuit of their specialties. Radio men should also know enough of antenna design, direction, and matching and of frequency selection to permit them to establish contacts in isolated spots by means of modifications to standard equipment in emergencies.

17. Magnetometer.

A study of metal-finding devices for use in locating snow buried ordnance, gas drums, vehicles, and similar items should be made. (See sec. VII.)

18. Gloves.

It is recommended that a study of suitable thin gloves or mittens be made so that personnel can properly manipulate knobs, small tools, and wire splices without removing them.

19. Water-Cooled Engines.

All water-cooled engines should be emptied before departure from the United States and again checked before being unloaded from the warm holds of ships into low temperatures.

20. Supply of Separate Groups.

Because of the ever-present possibility of small, separated groups being cut off from supply lines for days by blizzards, each such group must be self-supporting as to fuel, food, shelter, clothing, ammunition, and medical equipment. Failure to observe this precaution will cost more lives than enemy bullets.

COMMUNICATIONS (ACS)

SECTION I. Plans and Objectives

1. Provide communications between ships of the task force and with other commands ashore and afloat.
2. Provide communication with all planes, boats, and beach parties when away from parent vessels.
3. Provide communication and electronic facilities for air operations, construction parties, and trail parties ashore at temporary bases.
4. Operate electronic equipment as necessary for safety of all operations.
5. Provide communication and electronic facilities and aids to air navigation for all air operations over the Antarctic Continent.
6. Establishment of communication facilities at the emergency base camp for communication with the United States.
7. Provide communication facilities for press and broadcast.
8. Obtain technical and scientific data using electronic equipment.

SECTION II. Observations

1. Communication Between Task Groups (Command Circuit).

The Task Group Commander's circuit operated on 12 and 16 megacycles using a 500-watt transmitter (Navy type TBK) with a quarter wave vertical antenna and A-1 emission. In general the distances covered were about 3,000 miles. Receiving equipment was the standard Navy RBC receiver with a vertical antenna. All equipment was mounted aboard ships and was therefore not exposed to extreme climatic conditions. This circuit was used for weather, command, and administration and was entirely satisfactory.

2. Ship to Shore and Shore to Ship.

This circuit operated on 32.4, 28.4, and 36.8 megacycles using Army SCR-610 equip-

ment. These were set up in three nets with a master or relay station in each net. The distances covered were approximately 5 miles using A-3 emission. The SCR-610 are battery operated and only have a power of about 2 watts; therefore, this circuit could be used only when the ships were anchored to the Bay ice. The equipment was not new and a great number of equipment failures resulted. Chief among these were frequency shifts and instability. The "C" batteries were outdated and the extreme cold caused a noticeable voltage drop in the biasing circuit. (See Signal Corps Memo: Operation of Signal Equipment in Extreme Cold, published by SCEL, July 1946.) Added to this difficulty was lack of sufficient maintenance personnel. This phase of communications was, in general, considered unsatisfactory.

3. Air Navigational Aids.

a. Homing Beacon. The standard Navy YR Homing Beacon was used with a modified antenna instead of that normally supplied. The substitute antenna was an inverted L and was used in order to obtain greater range. The YR emits a modulated signal and is rated at 400 watts' output and operated on a frequency of 538 kc. The greatest difficulty in installation was failure to obtain a proper ground, which resulted in low output, and the effective distance of this equipment was approximately 100 miles. This is not considered sufficient range for a homing beacon in the Antarctic when flights extend to distances of 700 miles. The beacon used, when the aircraft flew from the carrier U. S. S. *Philippine Sea* to Little America, was a 2 kw. transmitter with a flat-top antenna mounted on board the *Mount Olympus*. The aircraft were able to pick up this signal immediately after becoming airborne and "home" the entire distance of approximately 600 miles. This was highly satisfactory. It was originally intended that the U. S. S. *Mount Olympus* remain in the Bay of Whales and act as a homing station and air-ground station, but due to heavy pack ice this ship was removed north to the vicinity of Scott Island and acted as a weather reporting station and general communication ship.

b. Ground Control Approach. This equipment was unloaded and put in position, but due to the cargo ships' being withdrawn early it was reloaded without ever having been used. During the time this piece of equipment was ashore a blizzard sprung up and it was interesting to note that the interior was filled with fine snow. The damage, if any, was not ascertained because the equipment was not operated. However, this should be corrected in all mobile types of equipment whether they are to be used in snow, sand, or dust.

c. Search Radar. The standard Navy GPN

radar, which is a self-contained unit complete with communication equipment, for communications with aircraft, was the only shore based, search radar, used. This is a band "X", 360-degree sweep, and is effective up to about 30 miles. This unit operated continuously during all flying operations and was highly successful, except for its limited range. The noise level in the high and medium frequency receiving equipment was noticeably high. This was attributed to the inability to obtain a proper ground.

4. Little America to U. S. A. (Washington, D. C., NSS).

This circuit used a standard Navy TBM transmitter, with an output of 500 watts CW. The receiving equipment was the standard Navy RBB receiver. Rhombic antennas were used for both transmitting and receiving, and tests were conducted on 3 and 6 mg. All equipment was located in heated buildings and was not subjected to extremely low temperatures. This circuit was used for test purposes only and was considered to be satisfactory. The only installation problem was in obtaining a satisfactory ground. (For other use of this equipment see par. 7.)

5. Press Broadcast.

The transmitter used for this purpose was a standard Navy TDH (2½-kw. using a folded doublet antenna and operated on 17 and 19 mc.). The terminal or "pick-up" point was New York. Over 90 percent of these broadcasts were successful. This is considered a good percentage in view of the fact that all broadcast times were controlled by the broadcast company in the States and were mostly chosen for the convenience of the company and not for the best operating time of the frequency period. All of the equipment was mounted on the *Mount Olympus* and was not subjected to extreme climatic conditions. The stand-by

transmitter was a 500-watt TBM and was used successfully on several occasions.

6. Radio Teletype Circuit from Central Group to U. S. A.

The transmitter used for this purpose was a standard Navy TBA 1-kw. and operated on various frequencies from 12 to 21 mc., using a vertical antenna. The receiving equipment was the standard Navy RBC receiver using a vertical antenna. This circuit was a duplex circuit and operated effectively about 12 hours a day. In addition to the radio teletype circuit, provisions were available to use a manual CW back-up and it was found necessary to operate manual about half of the time. The United States terminal of this circuit used rhombic antennas for both transmitting and receiving and therefore the percentage of RTTY reception was much greater on that end. The chief difficulty encountered on this circuit was lack of adequate space aboard ship to install proper type of antennas, and local interference from proximity of numerous other transmitting antennas to receiving antennas. In general this circuit was considered excellent. The traffic handled on this circuit was press releases, personal, and administrative.

7. Air-Ground Communications.

a. Portable Sets. (1) *Handy-Talky.* There were available for emergency use several SCR-536 (Handy-Talky) radio sets. Occasional ground tests were made and the distances covered were, in general, shorter than normal. This was attributed to the fact that available batteries were outdated, being dated 1944. No actual air-ground tests were made using this equipment.

(2) *M29C (Weasel Equipment).* Only one of the seven available Weasels were radio equipped, the set being an SCR-610 which was not suitable for air-ground operations

as the aircraft did not carry any equipment which operated on the same frequency range.

(3) *LVT (Landing Vehicle, Tracked) Communication Equipment.* The LVT's were equipped with Navy type TCS equipment which have a frequency range from 1.6 to 12 mc. This equipment proved satisfactory for air-ground communications and also for trail party to base camp communications over a distance of 100 miles. The only difficulty was that some tubes were broken due to vibration of the vehicles.

b. Fixed Station Equipment. (1) Originally it was planned to use the U. S. S. *Mount Olympus* anchored off the ice for this purpose, but due to unusual ice conditions it was necessary for this ship to be withdrawn early and a temporary set-up made at the base camp. This installation was made up in the main of airborne equipment consisting of two AN/ART-13 transmitters, one ARC/1 transceiver, and two BC-348 receivers. (Later RBC receivers were substituted to reduce noise.) The power for this station was obtained from a General Electric 200-ampere motor generator. It required an input of 3-phase 60-cycle 220-volt AC drawing 29 amperes. As a source of 220-volt AC an Onan gasoline driven generator (Model JWC4-10S-3) was used. The rated output of the motor generator was 29 amperes. This motor generator fulfilled the purpose except for one fault; it caused slight receiver noise. The maintenance of the Onan unit presented no problem and it was used continuously. It was stopped every 48 hours for an oil change and was refueled when necessary. It had a tendency to ice up but after erection of a canvas shelter this tendency vanished. SAE No. 10 oil was used without dilution and the engine was still in good condition at the end of use. This arrangement for a ground station did not prove adequate due to low power of

the AN/ART-13 transmitting equipment and the distances involved. To improve this condition the emergency station at Little America (approximately 2 miles away) was used as an alternate station and relay point. This station is described elsewhere in this report, the only alteration being that a vertical antenna was substituted for the rhombic.

(2) Due to two reasons ground to air communications were not satisfactory. First the relay necessary between Little America and the actual base camp caused delays and used additional personnel, which, although undesirable, was in view of the circumstances, unavoidable. Second, traffic other than actual ground to air traffic was at times handled on the ground to air frequencies by operators in spite of previous instructions to the contrary. This is poor practice and hazardous to good air operations. The inexperience of the operators was the cause.

c. Airborne Equipment and Air to Ground Communications. (1) The equipment used was standard Army and Navy airborne equipment consisting of the following: Command—AN/ARC-1 transceiver, AN/ARC-5 transmitters and receivers; liaison—AN/ART-13 transmitter and BC-348 receiver; altimeters—AN/APN-1 radio altimeter and SCR-718 radio altimeter; interphone equipment—AN/A1A-2A interphone and radio system; Radar—AN/APS-4 search radar and AN/APX-2A IFF equipment.

(2) In view of the fact that flying in snowstorms was anticipated the need of anti-precipitation antenna was foreseen. During the preparation of the aircraft at N. A. S., Norfolk, new compass sense antenna, new marker beacon, and flat-top antennas for the liaison and MHF command equipment were constructed, utilizing parts of antenna assembly kit AS/211/AR. All joints in antenna

wire WS-5/U were taped with a special dielectric tape. Before the antennas were installed on the aircraft they were tested for leaks at the joints with a high-frequency, high-voltage megger which generated 40,000 volts. When the antennas were installed on the aircraft, the joints at the lead-in insulators, the junctions of the strain insulators, and the mounting shackles were taped with dielectric tape. After these taped joints had been found to have no leaks, they were painted with flake shellac mixed with grain alcohol. In addition to making the joints corona-resistant, the shellac gave the joints more mechanical strength in that it prevented the tape from working loose. The joints were painted daily on the voyage to Little America, and by the date for fly-away the joints were covered with approximately one-quarter inch of shellac. Extreme caution was used when making the T splices for the lead-ins. Care was also taken that the antenna wire WS/5U was not nicked when removing insulation. Twelve static dischargers were installed on each aircraft. Three were in the trailing edge of each wing, two on the trailing edge of each horizontal stabilizer, and two on the trailing edge of the vertical fin. These anti-precipitation measures proved very effective during all the flying in the Antarctic.

(3) All air ground communications were considered satisfactory except as outlined in preceding paragraphs.

8. Power Supplies.

a. Shop Lighting and Test Equipment Power Supply. Power supply for shop lighting and test equipment was a PE-75. This equipment was housed and not exposed to the elements, and its operation was found to be satisfactory.

b. Aircraft Storage Batteries. Frequent pre-flight and installation checks of the aircraft

storage batteries were necessary to prevent them from freezing. (All batteries freeze when subjected to low temperatures unless fully charged.) Power unit HRU-28-A, mounted on a small man-drawn sled that could be pulled easily from aircraft to aircraft, was used to keep batteries at full charge.

9. Radio Photo Transmission.

Photo transmissions were made to Washington, San Francisco, and Honolulu, using a TBA 1 kw. transmitter and frequency shift transmission (8-13-19 mc.). All transmissions were scheduled. Considered to be fair to good.

10. Magnetic Effects and Wave Propagation.

All magnetic storm and Heaviside layer reflection data were taken throughout the trip by the U. S. S. *Canisteo*. This information is contained in the Navy report on this operation.

11. Conclusions.

Communication facilities and electronics implementation functioned sufficiently well to permit the operation to be run off successfully, although some improvements in communication are considered desirable. However, it is safe to state that communications and electronic systems as established will permit future successful Antarctic explorations

SECTION III. Recommendations

1. Personal.

In any Army Air Force operation such as this, it is recommended that an adequate number of highly trained personnel be provided to install, maintain, and operate communication and electronic facilities, thereby increasing the margin of safety in this type of operation.

2. Radio Range.

Original plans should call for installation of a radio range.

3. SCR-610.

SCR-610 radio sets should be deleted and later types of equipment of this same frequency range substituted.

4. GCA.

GCA equipment should be planned for and used.

5. Gliders.

Gliders with homing beacons, point to point radio facilities, and weather observers'

equipment should be considered for establishment of outlying, multiple purpose, stations. All equipment, including living facilities for personnel should be installed prior to shipment from the United States. Personnel for these stations should be capable of performing dual missions, i. e., weather observing and radio operating. Glider operations are considered feasible.

6. Ground.

Ice drilling equipment should be incorporated so that adequate grounds for all communication facilities may be obtained by drilling through the ice.

Note. Elaborate counterpoise system will still be needed.

7. Field Telephone System.

Original plans should call for the establishment of a field telephone system. The installation of field wire in this area presents very little problem. The moisture content of the snow surface is negligible, and the wire could be buried without danger of

failure. The surface is such that trenching is relatively easy. The incorporation of a camp telephone system would save time, transportation, and human energies.

8. Radio Teletype Circuits.

Original plans should call for additional radio teletype circuits to the United States, and these should be installed ashore. (This

is recommended to increase the available facilities for transmission of personal messages, thereby increasing the morale of troops.) It is also recommended, in connection with radio teletype operation, that additional rhombic antennas be installed for working Honolulu (Hickam Field) for relay to the States as an alternate routing of traffic when other circuits fail.

PHOTOGRAPHY

This chapter is a consolidation of reports written by two of the four Army photographers assigned to Task Force 68 as motion picture cameramen. General observations of photographic activities as seen by them throughout the expedition are given. The writers have purposefully avoided the inclusion of any technical material which was felt to be too comprehensive, since more detailed and specific reports may be found on this subject by referring to the photo-

graphic reports of Lt. C. C. Shirley, U. S. N., and Lt. H. H. Anglin, U. S. M. C., photographic officers for Task Force 68. This is especially true in regard to the trimetrogon survey which, according to the Operations Plan, was the primary photographic objective. The writers of the reports set forth below were assigned specific duties as motion picture cameramen, and having had no opportunity to do any trimetrogon work, did not feel qualified to report on such.

SECTION I. Task Force Plan

1. Scope of Photographic Coverage.

The primary photographic objective of Task Force 68 as listed in the Operations Plan was reconnaissance survey of all unexplored continental areas of the Antarctic with the trimetrogon aircraft camera installations in the R4D (C-47) aircraft operating from the Little America area and from the PBM-5 aircraft operating from the Eastern and Western Groups. Documentary, technical, historical, and in general, a complete pictorial record, to be obtained with motion pictures and stills in color and in black and white, was an important part of the photographic plan of the operation. The plan also stated that special efforts would be made to take newsworthy and human interest photographs, with a view toward press release through radiophoto and upon return to the United States (fig. 245).

2. Photographic Projects.

The following photographic projects were listed in the Operations Plan:

- a.* To make continental and coastal survey.
- b.* To obtain documentary film coverage of unloading, transportation, and construction operations.
- c.* To determine the photographic working day.
- d.* To record temperature and relative humidity.
- e.* To determine the color temperature of daylight and exposure data for color film.
- f.* To determine the types of film filters best suited for Antarctic photography.
- g.* To test photronic cell type exposure meters for accurate values.
- h.* To test effect of low temperatures on standard 4 by 5 film packs.
- i.* To test special lubricants for use in extremely low temperatures.

j. To test effects of sub-zero temperatures on camera lenses coated with low reflecting film.



Figure 245. T/5 Shimberg broadcasting (on Mount Olympus) an account of expedition directed to France. T/5 Shimberg spoke in French.



Figure 246. T/5 John Shimberg, U. S. Army movie photographer for Task Force 68 on Operation Highjump.

k. To obtain motion and still picture coverage of the following:

(1) Panoramic photographs from surface vessels of coast line, harbors, islands, and all aids and obstructions to navigation.

(2) Helicopter installations, facilities, and LVT operations.

(3) Various motor transportation.

(4) Establishment of airfield on the ice.

(5) Bearing power of field equipment on snow and ice.

(6) Structural properties of field equipment.

(7) Tests of various items of equipment and material to determine their feasibility for construction work under cold weather conditions.

(8) General field experience of naval construction battalion personnel.

(9) Unloading cargo.



Figure 247. Shooting movies of the bow of the U. S. S. Burton Island cutting her way through Ross Sea ice pack on the way home.



Figure 248. Briefing pilot prior to helicopter flight for aerial photographs.

- (10) Tests of clothing.
- (11) Items applicable to Marine Corps.
- (12) Tests of temporary camp expedients.
- (13) Messing facilities.
- (14) Tests of lubricants, greases, oils, engine coolants, and hydraulic fluids.
- (15) Tests of engine heaters.
- (16) Rescue and survival operations, showing technique and procedure.
- (17) Measurement of time variations of earth's magnetic field.
- (18) Airborne geological survey.
- (19) Radar scope recordings of interesting weather indications of various types.
- (20) Damaged or modified electronic equipment.
- (21) Base radio installations.
- (22) Launching and handling of "Kytoon" balloon and related accessories.

(23) Special electronic installations.

(24) Photographic equipment installed in PBM and R4D type aircraft.

3. Coverage Obtained.

a. The following general coverage was obtained both in color and black and white stills, with color stills at various times. In addition, many other subjects were photographed during the expedition.

- (1) Departure from Norfolk, Virginia.
- (2) Arrival in Panama (transit through canal).
- (3) Refueling at sea.
- (4) Crossing the Equator ceremony.
- (5) First iceberg.
- (6) Issue of cold weather gear (Army and Navy).
- (7) Rendezvous at Scott Island.
- (8) Transit through the ice pack (figs. 246 and 247).
- (9) Flights of the helicopter and seaplane for reconnaissance work (figs. 248 and 249).
- (10) Arrival at barrier.
- (11) Entering Bay of Whales.
- (12) Mooring ships.
- (13) Unloading.
- (14) Building bridges over crevasses.



Figure 249. J2F aboard U.S.C.G. Northwind.



Figure 250. Installing trimetrogon cameras in R4D.

(15) Transit of equipment over barrier.

(16) Erecting tent camp, mess hall, food caches, motor pool, airstrip, and dog town.

(17) Life in a tent, blizzards, and snow life.

(18) Revisit to Little America III by former members (1939-41 Expedition).

(19) Life in camp Highjump.

(20) Arrival of R4D's with Admiral Byrd.

(21) Departure of ships.

(22) Photographic flights of R4D's (fig. 250).

(23) Rendezvous at Scott Island of all men.

(24) Leaving Antarctica.

(25) New Zealand liberty.

(26) Panama and arrival in Washington, D. C.

b. The motion picture and still coverage was as good as could be expected in such a short period of time on the ice. All 30 photographers worked hard to obtain the history of Task Force 68. Except for a few minor details, the photographic schedule of the expedition was completed as directed. Many of the handicaps were due to failure of equipment and not of the men. Cameras had no special protection from drifting snow and were not properly winterized. The equipment was not by any means the best of its kind.

SECTION II. Personnel and Assignments

1. Complement.

Lt. C. C. Shirley, U. S. N., was the photographic officer for all of Task Force 68 (fig. 251). Lt. H. H. Anglin, U. S. M. C., was the motion picture officer for all of Task Force 68. These two staff officers were on the U.S.S. *Mount Olympus*, the Flagship, in the Central Group. In addition, personnel were distributed as follows, among the three groups:

a. Central Group.

1 Lieutenant (jg), U. S. N.

1 Warrant officer, U. S. C. G.

4 Chief photographer's mates, U. S. N.

11 Photographer's mates, first class, U. S. N.

3 Photographer's mates, second class, U. S. N.

4 Photographer's mates, third class, U. S. N.

1 Master sergeant, U. S. M. C.

1 Sergeant, U. S. M. C.

2 T/5, U. S. A.

b. Western Group.

1 Lieutenant (jg), U. S. N.

4 Chief photographer's mates, U. S. N.

4 Photographer's mates, first class, U. S. N.



Figure 251. Photographer's tent.



Figure 252. Photographer in Antarctic foul weather clothing operating Mitchell camera.

2 Photographer's mates, second class, U. S. N.
4 Photographer's mates, third class, U. S. N.
1 T/5, U. S. A.

c. Eastern Group.

3 Chief photographer's mates, U. S. N.
8 Photographer's mates, first class, U. S. N.
1 Photographer's mates, second class, U. S. N.
2 Photographer's mates, third class, U. S. N.
1 T/5, U. S. A.

2. Work Schedule.

a. With the extensive amount of coverage to be accomplished in such a brief time, photographic work throughout the operation was at a high pitch. All personnel worked to the best of their ability to obtain as complete a photographic coverage as possible of every phase of task force activity.

b. Photographic watches (figs. 252 and 253) were maintained from the time the ships of the Central Group entered the Antarctic waters until they departed from them. Before entering the ice pack on 31 December, 1946, Lt. Anglin, one Navy photographer, and the two Army photographers transferred with Admiral Cruzen and his staff to the U. S. C. G. *Northwind* for the transit through



Figure 253. Photographer using K-18 aerial camera on flying bridge of U. S. S. Mount Olympus.

the ice pack. All four photographers maintained a daily working schedule from 0600 until 2400, after which one was left on watch; but in the event that anything occurred which demanded special photographic coverage, the other photographers were called to assist (fig. 254). On 18 January unloading operations of the U. S. S. *Yancey* began in the Bay of Whales. A photographic party, consisting of two photographic officers, two chief



Figure 254. Photographer leaning over rail of U.S. C. G. Northwind shooting movies of the ship's bow breaking the ice.



Figure 255. Lt. C. C. Shirley, U.S.N., and Lt. H. H. Anglin, U.S.M.C., photographic officers, discussing photographic problems in mess hall at base camp.

photographer's mates, six Navy photographer's mates, and the two Army photographers went ashore immediately with the first unloading and maintained a complete and comprehensive coverage of all operations until the last loading on 24 February 1947. A work schedule of 8 hours on and 8 hours off was maintained at first, but this was soon changed to 12 hours on and 12 off. These 10 photographers worked in two shifts of one photographic officer and four men each. A 24-hour working schedule was possible due to the around the clock daylight. The 12-hour working shift was maintained regularly except for special events, such as the arrival of the R4D airplanes at Little America, when both shifts of photographers were called out. In fact, during the trimetrogon aerial survey, one photographer put in a

56-hour stretch. Thirty hours without rest was not unusual for some of the photographers. The rest of the photographic unit was on the ship manning the photographic laboratory during this time, carrying through the developing and printing of film shot on the ice. The work schedule maintained aboard the U. S. S. *Mount Olympus* after Little America was evacuated, 24 February 1947, until her arrival back in the States was that of two 12-hour shifts, night and day. All aerial film was developed and printed at this time, and 4- by 5-inch prints were turned out for official reports.

3. Briefing.

A certain amount of briefing was given by Lt. C. C. Shirley, U. S. N., veteran photographer of the preceding expedition, during

the trip down to Antarctica. It consisted of motion picture footage taken by him on the previous expedition, general information on Antarctic environment, photographic exposure, and a check list of the subjects to be covered on the ice. This type of briefing both before and after reaching the ice is invaluable. The more briefing, the better understanding a photographer has of what he is doing and is expected to do. Efficient supervision and a complete background through briefing are the two keys to successful photographic coverage in the Antarctic, since so few are thoroughly acquainted with its irregularities of nature (fig. 255).

4. Type of Assignments.

a. Complete documentary photographic coverage was given to every phase of the entire operation. An eye was always kept open for good public relations pictures (fig. 256). Several pictures were sent back to Washington, D. C., every night by radio-photo throughout the expedition's operations in the Antarctic. Similarly, motion picture material suitable for newsreels and a

possible Hollywood featurette was obtained

b. Assignments were varied and included such subjects as penguins, cargo sled tests, tent life, airstrip construction, life in a blizzard, feeding the dogs, digging out Little America III, Antarctic transportation, scientific activities, mess hall activities (fig. 257), cargo hauling up the barrier, and bridge construction over a crevasse (fig. 258).

c. Double coverage was necessary on certain important assignments, such as the arrival of the R4D (C-47) airplanes at Little America from the U. S. S. *Philippine Sea* on 31 January 1947. The value of double coverage was illustrated on this occasion. All ten photographers on the ice were alerted. The equipment used was as follows: three Eyemos, two Mitchells, two Cine Specials, and three Speed Graphics. The temperature that morning was -1° F., and two Eyemos and one Speed Graphic failed because of freezing. All cameras had important angles to cover, but without the double coverage, little might have been obtained because of camera failures caused by low temperatures.

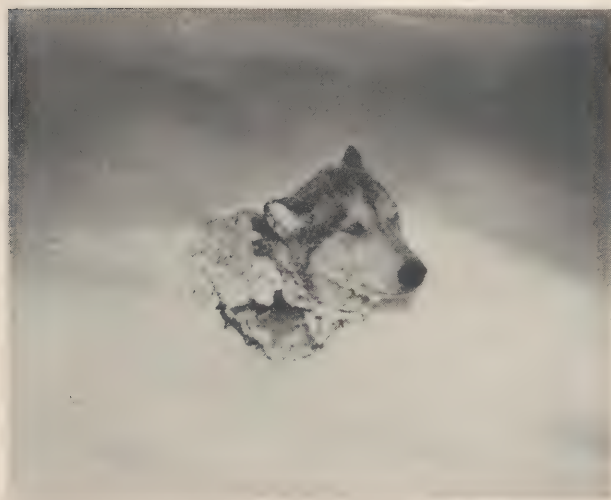


Figure 256. Sledge dog covered with snow.



Figure 257. Mitchell and Cine Special Cameras in use on an indoor job covering mess tent activities.



Figure 258. Three photographers tend line to another photographer who is shooting pictures from inside a crevasse.

SECTION III. Equipment

1. Requirements.

The amount of camera equipment required by the Task Force was affected of necessity by two things: (1) dual parts and (2) dual coverage. The first of these may be explained by saying that in a far away continent such as the Antarctic, a photographic unit must have parts or cameras in duplicate to allow for possible failures. Duplicate coverage means that on certain important assignments, it was necessary to have two cameras of each type operating so that if a camera blocked out completely, coverage by that type of camera was insured.

2. Film Exposed.

The total amount of film exposed, in round numbers, was as follows:

Motion picture film: 165,000 feet (all types).
Still film: 4,500 negatives.

3. Types of Equipment.

The amount of camera equipment (except trimetrogon) used for all three groups of Task Force 68 was—

a. Motion Picture Cameras (Total).

(1) 14 Bell and Howell Autoloads.

(2) 36 C. S. A. P.'s

(3) 12 Mitchells.

(4) 14 Kodak Cine Specials.

(5) 10 Eyemos.

b. Still cameras.

(1) 20 Speed Graphics.

(2) 2 8- by 10-inch view cameras.

(3) 12 K-20 aircraft cameras with focusing attachments.

(4) 7 F-56 (8¼-inch) aircraft cameras.

SECTION IV. Operation of Equipment

1. Obstacles.

Operation of photographic equipment under sub-freezing temperatures is probably one of the most difficult tasks in the field of photography. (See figs. 259 and 260.) The Antarctic with its sastrugi surface, its knifing wind, and its frigid temperatures presented many operational problems to the photographer. Mobility in covering action and speed in changing film are two important points in good photographic coverage, particularly in the field of motion pictures. Both were slowed down considerably in this operation due to many detracting factors of cold weather.

2. Motion Picture Cameras, 16-mm and 35-mm.

The motion picture cameras used to film the expedition were Mitchells, Eyemos, Cine Specials, and Speedsters.

a. Eyemo "Spider." This camera (35-mm hand-wound, 100-foot rolls) was not worthy at all. It had very little winterization, collected emulsion at all temperatures, froze solid at 0° F. (inside Little America III), the lenses were not coated, and aperture plates were not beveled. In general, it worked poorly, but if it had worked properly, it would have been of great advantage.



Figure 259. Breath has frozen to beard and formed a mask of ice.

b. Mitchells (Hi-Speed and Standard). These cameras ran almost always and were the standard cameras used on the ice. Batteries for these cameras were not adequate, being too heavy (40 lbs.), and too big (12-v., 115-amp., motion picture batteries).

c. Cine-Specials. These cameras (16-mm, hand-wound, 100-foot rolls) were very good down to temperatures of -25° F. The motors ran well and little is to be said on their condition, although much snow accumulated in the lenses, blown in by the wind when used outside.

d. Speedsters. The Speedsters (16-mm, 50-foot magazine load, hand-wound) froze up at about -10° F., but worked fine in every way down to that temperature.

3. Still Cameras.

The still cameras mostly used on this expedition were 4- by 5-inch Speed Graphics,

4- by 5-inch Graflexes, and 35-mm Kodaks.

a. Speed Graphic. The 4- by 5-inch Speed Graphic worked properly down to -5° F. Some cameras had a little trouble with flash synchronization. Keeping lenses clean of snow and fogging was a big problem. Filmpack tabs froze in cameras in storms and were difficult to pull out, causing spoilage of some pictures. Range finders froze up, making focusing harder for the photographer. After a good day's work, cameras had to be stripped and hung up to dry over the tent's stove. This was due to the inability of removing all drifted snow before entering the tent.

b. Graflex. The 4- by 5-inch Graflex worked down to temperatures of -25° F., and the comments made on the Speed Graphic in *a* above apply equally to the Graflex.

4. Tripods.

The Mitchell tripod and Pro-Junior were the two tripods used mostly on the ice; the Cine-Kodak tripod was used on the ship.

a. The Mitchell proved satisfactory down to temperatures of -20° F., when the pan and tilt bearings became difficult to operate.



Figure 260. Photographers covering ships of Task Force 68 getting underway in Bay of Whales for home (Cine Special, Mitchell, and F56 cameras being used; Speed Graphic on the ice).

b. The Pro-Junior also proved satisfactory down to temperatures of -10° F.

5. Motors.

The motors for the Mitchell cameras began slowing down intermittently at temperatures of $+20^{\circ}$ F., but operated effectively at -10° F.

6. Film.

a. Motion picture film, both 35-mm and 16-mm, became quite brittle and broke often from temperatures of $+10^{\circ}$ F. down. This occurred mostly in threading spools; film was very sharp when cold, and several finger cuts resulted from this. Heavy gloves could not be worn during loading, making the operation difficult and longer.

b. Still films were no trouble as far as is known except for film sticking to cut film holders, sweating when brought inside from the cold, and filmpack tabs breaking off halfway out.

7. Exposure Meters.

General Electric photographic exposure meters proved very useful when used properly, and were of great assistance to all photographers. (See par. 15, sec. VI.)

8. Film Cans.

Adhesive tape on film cans froze up and lost its stickiness right at the freezing point ($+32^{\circ}$ F.), and therefore had to be heated to stick to cans. This proved to be a continuing inconvenience.

9. Transportation.

a. Since the photographic unit was not able to retain a Weasel of its own for the entire operation, immobility as previously mentioned hindered activity. A photographer walking to an assignment, if it were any distance, found the sastrugi physically wearing and the wind often freezing, both of

which placed him in poor condition to cover an assignment. There was also the possibility of his camera being clogged with snow (whipped up by the wind in his transit) and also its being frozen by a penetrating wind.

b. In addition, while covering a job, specifically in the case of the motion picture cameraman, changing camera angles and maintaining continuity is almost impossible, even with an Eyemo. With a Mitchell, it is more than a task. The tripod usually sinks at least a foot into the snow, never evenly, thus taking additional time to level the camera before shooting. To change camera position in order to maintain a variety of angles calls for pulling the tripod out of the snow, placing it on the shoulder hoping that the tilt will not unlock, floundering with the tripod legs over the semi-hard surfaced snow which breaks through every step or two due to the extra weight, and then going through the process of setting up the camera all over again. The 12-volt battery must then be dragged over and connected to the camera. The scene is then focused and photographed while it is hoped that there is still enough action. In cold weather it is usually too much to ask a person to re-enact or delay a certain action for the sake of taking pictures (figs. 261 and 262).

c. Film magazines for the Mitchell were usually loaded in the photographic tent and taken out with the camera on assignments. Since the magazine case was cumbersome and fairly heavy, it was usually left in the photographic tent, Weasel, or some central spot near the action being photographed, rather than carry it with the camera at every angle change. Other motion picture cameras, such as the Eyemo and Kodak Cine Special, used the photographic Weasel when it was available as a semi-shelter for loading the cameras. Without some sort of shelter, loading time was practically tripled. The Weasel also prevented the undesirable situa-



Figure 261. Photographer on skis carrying Cine Special and Graphic.

tion of unloading a camera by placing it on the surface of the snow (fig. 263).

10. Changing Film.

The pros and cons for changing film in the cameras used are many and varied.

a. The Eyemo, using 100-foot film rolls, gave a cameraman excellent mobility as it was operated hand-held and enabled the operator to move about and follow action freely. Changing film after every 66 seconds of action is enough to slow one down, but under cold temperatures and with freezing hands speed along these lines goes slowly indeed. It might be mentioned here that it was found to be impossible to change film in a motion picture camera while wearing gloves or mittens (fig. 264). This is an important

element in the operation of cameras in cold weather.

b. The Mitchell had more mobility than the Eyemo in the sense that it took one-quarter of the time required by the Eyemo to change film. However, the actual threading of the Mitchell was just as difficult and time-consuming as any other motion picture camera, other than the Speedster. The use of 1,000-foot magazines instead of 400-foot magazines would have cut film-loading time to one-tenth that of the Eyemo.

c. The Kodak Cine Special offers the same film-loading problems as the Eyemo, except that two 100-foot magazines can be loaded before going out on an assignment.

d. The Speed Graphic 4- by 5-inch film pack was definitely more desirable for cold weather usage than cut film. Time saved placed it beyond approach. One of the retarding factors in the use of film pack



Figure 262. Photographer moves equipment (Mitchell camera) to a new location while on an assignment.



Figure 263. T/5 Waltersdorf loading Eyemo on a slate in the snow.

was that care and a steady pull were necessary in changing film from one negative number to another so as not to break the film, which was usually stiffened and made more brittle by the cold. Great care also had to be taken to avoid moisture from melted snow on the film packs while changing from one to another.

e. The Speedster, being of the magazine or automatic load type camera, as well as a very light one, gave little or no difficulty in changing film. Several photographers reported minor difficulty in seating the magazines due to shrinkage of the metal casing.

11. Sighting Cameras.

a. General. (1) Except for the Mitchell with its detached view finder, great difficulty was encountered in sighting action with all types of cameras, the main difficulty being the close contact of the face with the cold metal surfaces of the camera. Sighting with sun glasses also promoted a problem as did view finder condensation from the camera-man's breath.

(2) Fogging of camera lenses, view finders, glasses, and range finders would slow up the work of the photographer considerably and at times make him miss important shots.



Figure 264. T/5 Shimberg loading Mitchell magazine on ice.

b. Eyemo. The Eyemo caused this observer a great deal of difficulty with its view finder's freezing over from breath condensation. Sun glasses made it very difficult to sight although it was possible to become adjusted to this way of sighting. One had to learn to push the camera against the glasses and in toward the eye as far as possible. The glasses did afford some protection for the face from the cold metallic surface of the camera. A face mask, when worn, also gave protection (fig. 265). An additional item in regard to this camera's view finder, which was of a turret type, is that it did not seat properly when changing from one corrective to another, due to metal shrinkage.

c. Mitchell. The Mitchell gave little trouble as to sighting, except when it had to be hand-cranked—no action could be followed or panned with the friction head tripod.

d. Kodak Cine Special. The trouble with the Kodak Cine Special is that the method of holding the camera brings the face into contact with the cold metal surface. Condensation was bothersome on the view finder as well as snow which collected on it very easily.

e. Speed Graphic. Condensation and sun glasses presented no problem with the wire



Figure 265. T/5 Waltersdorf wearing face mask while shooting with Eyemo during a blizzard.

view finder but did with the telescopic type view finder and particularly the range finder. Cold metal parts of the camera coming in contact with the photographer's face did give some trouble.

f. Speedster. Sun glasses, condensation, and cold metal promoted problems when sighting this camera, but no more than any other.

12. Lenses Drifting with Snow.

a. All cameras were susceptible to this problem since wind and snow are two major things encountered in the Antarctic. In regard to this, several things should be mentioned of practical importance. Cameras like the Mitchell were quite often situated in strategic points as duty cameras with one shift of photographers relieving another. Occasionally, these cameras were not in use for short periods of time. When inactive it is necessary to cover the camera, particularly the lenses, from the wind. In some

cases an ordinary changing bag was used for this purpose. If this was not done, lenses drifted with snow.

b. When using any camera during a blizzard or on days when the wind is blowing a great deal of snow around, all lens shades should be removed. These shades act as a collecting agent and cause snow to go into the lens more than it would otherwise. In the Antarctic the snow is very dry and powdery and unless the camera lens is warm, snow will not collect on its surface, but will blow off readily.

13. Actual Operation of Cameras.

Difficulty was had with some of the cameras in actually shooting them. The main reason for this was that the gloves and mittens worn by the photographers were clumsy and caused trouble in pressing the camera starter. This was especially true of the Eyemo and Speedster. The Speed Graphic gave some trouble for this reason, when setting the shutter aperture.

14. Clothing.

a. General. Light but warm clothing would be of great advantage to all photographers since they do a great deal of walking with cameras and equipment. A very useful piece of clothing was the Navy issue of "windproof top" with chest pocket where all sorts of little things could be easily carried (film, lenses, filters, notepad, etc.). One of the bad things about photography was the constant removing of gloves to reload, fix things, write data, or clean off the cameras. Hands would get too cold and numb to work and would have to be warmed up before operations could be continued.

b. Weight Versus Activity. Light, windproof snow suits were worn by most of the photographers and proved most satisfactory. Photographers perform an active type of work in which ease and speed of movement



Figure 266. Photographer checking equipment prior to starting off on an assignment.



Figure 267. T/5 Waltersdorf shooting the Mitchell camera while wearing windproof suit.

are important. Camera equipment is usually cumbersome enough without the extra burden of heavy and bulky clothing. Unfortunately, there were times when a photographer had to stand around waiting for the action of a certain assignment to begin, and it was during these lulls that the photographer was coldest, especially his feet (fig. 266). On the whole the clothing used was light and warm enough for the type of work done (fig. 267).

c. Pockets. The blouse of the windproof snow suit was also practical in that it had a huge Kangaroo pouch type pocket in the front. There are many photographic accessories, such as caption sheets, pencils, chalk, slates, orange sticks, in addition to camera cranks and film which a photographer must keep on his person for use on short notice. A musette bag is good for this purpose, although sometimes (depending on the assignment) it is too large. The patch pocket



Figure 268. Two photographers changing film in the Mitchell. (Note that one has removed gloves to increase dexterity.)

on the windproof blouse was very practical and fulfilled a great need.

d. Gloves. This item constituted one of the most important personal problems encountered. Uncovering of at least one and usually two hands for changing film and shooting a camera was almost unavoidable. This observer wore a pair of knit woolen gloves inside a pair of shell leather mittens. In order to change motion picture film, it

was necessary to remove both (fig. 268). This could be done only for short periods of time, depending on the wind and temperature. The Eyemo motor button was hardest to push due to the thickness of the gloves and usually called for the removal of the right-hand glove and mitten until the end of the scene was completed. Sometimes it was possible to operate the button by removing the shell mitten only.

SECTION V. Cold Weather Problems

1. Mechanical.

a. Eyemo, Spider. (1) The Eyemo on the whole proved unsatisfactory for cold weather motion picture photography. With a spring tension motor such as this camera uses, full motive power is lost at low temperatures due to the fact that the spring steel used in the motor loses its full tension. From temperatures of 32° to 0° Fahrenheit this camera worked spasmodically, and below 0° Fahrenheit proved to be completely unreliable. Two important factors were evident: (1) age and (2) condition of the aperture plate. Most of the cameras used were old and had already lost some of their motor tension. As a result, they were more susceptible to a further loss at freezing temperatures. The condition of the aperture plate was very important as is the case in using the Eyemo anywhere. Despite the fact that film shrinks at cold temperatures, the aperture plate still collects emulsion at the slightest scratch or abrasion. With less tension in the motor due to the cold the camera will practically stop at the slightest evidence of emulsion on the aperture plate. The cameras used did not have beveled aperture plates.

(2) Another factor encountered in this camera's "jamming", in addition to the col-

lection of emulsion on the aperture plate, was "loss of loop". The film, having shrunk in the cold, had a tendency to slip through the lower sprocket and lose a hole or two if there was much pull from the take-up spool. As a result, the film would lose its correct 8-10 loop, thus jamming the camera. This was counteracted somewhat by adding an extra sprocket hole or two, particularly to the bottom half of the loop.

(3) It was also observed that the camera was slowed down if the back pressure plate was seated too close to the aperture plate. The reason for this was that the motor was not capable of bearing the slightest amount of extra tension. By pulling back the pressure plate a *very* slight amount, the camera ran much more smoothly (at temperatures down to 0° F.). It is not believed that "ghosts" resulted in the exposed film since film is much stiffer in cold temperatures and pulls through smoothly.

(4) The 400-foot magazine when used with the Eyemo, the few times that it was, proved unsatisfactory. It was almost as cumbersome as the Mitchell and did not perform one-half as well mechanically. Another difficulty encountered was with the plunger at the back of the camera

which opens the throats of the magazine. When the lid of the Eyemo was put on the camera after threading, it did not push the plunger in far enough to open the throats completely. As a result, the additional tension proved to be too great for the motor at times.

b. Mitchell. Mechanically the Mitchell proved to be the most proficient motion picture camera for cold weather use. (The coldest temperature in which it was used was -29° F.) Three of the four Mitchell motors failed, which meant that all but one of the Mitchell cameras had to be hand-cranked. The one motor which performed successfully under Antarctic conditions was the smaller and older type motor. Since all four were regular 12-volt Mitchell motors, further investigation is recommended as to the reason for failure by the larger and newer type models. Old batteries caused some trouble. New 12-volt wet cell aircraft batteries were satisfactory in every respect (fig. 269).

c. Kodak Cine Special. The efficiency of this camera proved to be very high and little trouble was had with its operation in temperatures down to 0° Fahrenheit. In temperatures down to -20° Fahrenheit it functioned properly except when kept in the cold for more than an hour or two.

d. Speed Graphic. This camera worked successfully at all temperatures encountered down to -10° Fahrenheit when the camera had been winterized. Flash synchronization had a tendency to lag at temperatures below 0° Fahrenheit, mostly with slower shutter speeds. The flash gun batteries froze up in several instances at these low temperatures.

e. Speedster. This camera was used on the aerial flights under temperatures of -30° Fahrenheit and worked successfully for short periods of time before freezing. The camera could then be heated in the pilot's cabin

and used again. However, in some cases it was inefficient in its performance on the ice at temperatures around 0° Fahrenheit. An explanation for this may be had in the fact that some of the cameras used were older than others. Another factor, as was the case in most of the cameras, was that on the ground there was more wind and not merely a still cold. As a result, with a stiff, cold wind a camera might freeze up sooner at 0° Fahrenheit than when used in a still cold of -20° or -30° Fahrenheit.

2. Lubrication and Winterization of Cameras.

a. Eyemo. These cameras were winterized. ANO-6A oil was put in all cameras but no grease was used other than the flake graphite already in the cameras.



Figure 269. Photographers shooting movies from the photographic Weasel. The 12-volt wet cell aircraft type battery used with the Mitchell is in the foreground.

b. Mitchell. These cameras were winterized. ANO-6A oil was put in the cameras and excess ANG-3A low temperature grease was removed.

c. Kodak Cine Specials. These cameras were winterized or lubricated at the factory with special low temperature oil or grease (ANO-6A and ANG-3A). Their performance was very satisfactory.

d. Speed Graphic. These cameras were winterized. All oil and grease were removed from the camera. Powdered graphite was used in lubricating all working parts.

e. Speedster. These cameras were not winterized.

3. Exposure.

Exposure was very tricky and an exposure meter had to be used. Readings were taken in the shade at all times for long and medium shots and for close-ups on the faces of subjects. On certain overcast days a reading at the sky would be lower than a reading taken of the ice or snow due to an apparent added light component caused by reflection from the clouds.

a. Human Judgment. The fallacies of human judgment, it was found, are so great that one can rely only on a light meter for a true exposure in Antarctic photography. There are many reasons for this. With photography on ice, the problem of reflected light is greater than that of direct light. This is true not only on days of bright sunshine but also on overcast or "milky" days. Light meter readings taken on the ice showed a higher reading pointing downward toward the ice surface than upward to the sky. This excess of reflected light is misleading to one's judgment and results in the tendency to overexpose in regard to details. The best procedure in fixing exposure is to take a light meter reading of the shadows. This is particularly true in the case of photographing people or things.

For general icescapes an over-all reading is the better type. Photographs made by exposing for detail in the main subject produced the best results. General Electric light meters were used primarily and proved satisfactory.

b. Additional Factors. Two additional factors might be mentioned also in regard to Antarctic light exposure.

(1) Although during the Antarctic summer, light is continuous 24 hours a day, its intensity and position change. The human eye, however, becomes accustomed to continuous daylight and fails to notice any change of intensity.

(2) Due to continuous daylight and so great an amount of reflected light from all angles, sun glasses or goggles are standard equipment and are worn continuously while working on the ice. As a result, reliance on the human eye for exposure usually fails to compensate for this reduction of light intensity.

c. Color Exposure. The procedure for Kodachrome, Kodacolor, and Ansco color photography on the ice was the same as for black and white photography. Exposure was made for detail by taking the light meter readings in the shadows. Photographs taken in this way on bright, sunny days produced some of the most beautiful pictures taken throughout the entire operation.

d. Filters. Filters are of little use in the Antarctic. The atmosphere is clear and there are no dust impurities or haze to contend with such as are found in other sections of the world. Use of filters was in general restricted to two situations:

(1) As an exposure control when a camera would not step down far enough for high-speed film (the black and white film used was speed group 100).

(2) To correct for the high temperature sensitivity of color film by use of a color compensating filter.

e. *Test Strips*. Test strips were made in the photographic laboratory aboard the U. S. S. *Mount Olympus* for 35-mm motion picture film in such cases where exposure was doubtful. In general the motion picture men relied on the results which the still photographers were having with their pictures on the ice, using those exposures which produced the best results for them.

4. Processing.

All processing in the Antarctic was done in the photographic laboratory aboard the U. S. S. *Mount Olympus* (fig. 270). Still film was sent back to the ship for processing every day. No laboratory was set up on the ice at any time. All Kodachrome and motion picture film was mailed to the United States at the earliest opportunity, for processing.

5. Materials.

a. *Metal Shrinkage*. Metal shrinkage in the cameras due to below freezing temperatures was not noticeable since most of the cameras were winterized. The most noticeable case was in that of the motion picture camera tripods used, both the Mitchell tripod and the Professional Jr. These tripods have friction heads which are very troublesome under freezing temperatures. This was particularly true in the case of the Mitchell tripod, which when used with the Mitchell camera caused no end of difficulty in locking the "pan" and "tilt". The tripod legs also lost their necessary stiffness and played havoc with a cameraman when he attempted to change position. Carrying the Mitchell on one's back was bad enough, particularly with the uneven and pitted terrain which a snow surface presents, but to have the tripod legs swinging loosely and the "pan" and "tilt" coming unlocked at the slightest pressure caused many irritable experiences.

b. *Film*. The film, both motion picture and still, was affected by the subfreezing



Figure 270. Sonne printers in operation in the darkroom aboard the U. S. S. *Mount Olympus*.

temperatures. A stiffening and some shrinkage of the film was noticeable. It did have a certain amount of brittleness to it and cutting of the fingers as well as breaking of the film was observed in a few instances. On the whole, little difficulty was encountered with this. If care was taken when loading motion picture cameras and when pulling out a new exposure on a 4- by 5-inch film pack, little trouble was had with broken film due to its brittleness. As is to be expected, any undue tension brought to bear resulted at times in film breakage, particularly at temperatures below 0° Fahrenheit.

6. Condensation.

Difficulty with condensation was encountered in the Antarctic only when taking a camera from the cold outside into a warm tent. The reverse of this gave no noticeable condensation troubles. Lens tissues had to

be carried at all times by the photographers so that if they entered a warm tent with their cameras after an assignment, they had something with which to clean off the lens condensation immediately. This was particularly true if the temperature change was large and sudden. Melting snow contributed

to moisture on cameras which had just been brought in out of a blizzard, still covered with snow, which would melt causing excess moisture.

7. Storage of Equipment.

Photographic equipment under cold weather conditions must be stored with two things in mind—availability, and a minimum of temperature change from storage to operation. During photographic activities at Camp Highjump atop the Ross Shelf Ice, three main points or places were used for this purpose:

Photographic tent.

Weasel.

Tent quarters.

a. Photographic Tent. The photographic tent was situated in the “operations” area alongside the airstrip. It was a 17- by 20-foot tent and the main part of the photographic equipment was stored there. Crates and boxes were used in making shelves along one side of the tent for storage of film, data sheets, tape, and all types of photographic



Figure 271. Photographers laying floor of photographic tent.



Figure 272. Interrogation of night shift photographers while bringing photographic log up to date.



Figure 273. Photographers moving heavy boxes of photographic equipment at base camp. Note photographic tent with window cut out in background.



Figure 274. Changing bag being used in reloading a 400-foot Mitchell magazine in photographic tent. Film is stored on shelves in background.

accessories. Along another side, a long work table was built out of crates and used for writing caption sheets, loading, repairing, and temporary storage of cameras. Camera cases were lined along the other sides, loaded and ready for use at all times. This tent was the headquarters for all photographic activities. With an assigned Weasel, photographic coverage was possible anywhere, anytime. The tent contained a small Diesel oil stove which managed to take the chill off the tent but did not warm the tent enough to worry about condensation. (See figs. 271, 272, 273, and 274.)

b. Weasel. The photographic section was able to procure one of the Weasels for its exclusive use during the first part of the operation. During this period, the Weasel became a natural storage point. A Mitchell,



Figure 275. Mitchell movie cameras in operation on bow of "photo" Weasel.

Speed Graphic, Eyemo, Speedster, and F-56, all loaded with film, plus extra film, magazines, caption sheets, and additional accessories were always kept in this vehicle. It became a veritable camera truck, with the Mitchell mounted on the bow (fig. 275) ready to go out on assignment anywhere on a moment's notice. This Weasel, equipped as it was, gave to the photographic unit a valuable mobility which is a prerequisite for good photographic coverage (figs. 276 and 277).

c. Tent Quarters. Tent quarters as a storage point became important after a motor pool was established and the photographic unit lost its personal Weasel. If a rush assignment presented itself, transportation became the bottleneck—both to alert personnel at their tent quarters, and to obtain the



Figure 276. Photographic Weasel in use on an assignment.



Figure 277. T/5 Waltersdorf shooting Mitchell, anchored to bow of Weasel, as the Mount Olympus hurriedly pulls out during an iceberg emergency.

cameras at the photographic tent (about one-half mile distant), as well as to reach the place of assignment. Therefore, a Speed Graphic and a loaded Eyemo were usually kept in the tent quarters along with some extra film in case a rush assignment should

occur. The temperature change involved was usually not great enough for condensation to result, but as a precaution, cameras were placed on the floor near the wall (leeward) of the tent, thus maintaining a more even temperature.

SECTION VI. Recommendations

1. Eyemo Camera.

a. An Eyemo with a beveled aperture plate should be used to avoid collection of emulsion.

b. A 9 to 11 sprocket hole loop should be used in threading an Eyemo under cold weather conditions instead of an 8 to 10 loop to avoid loss of loop and resultant camera "jam".

c. Eyemo "Spider" (turret, 3 lenses, 35-mm). The Army single lens combat Eyemo with beveled aperture plate would be more successful than the Navy "Spider". If these cameras are to be used, they should all have neutral density filters for all lenses, since the

stops on some lenses are not small enough for the terrific amount of light found in the Antarctic. The lenses should also be coated like the Army combat Eyemos. Beveled plates and proper winterization would make this type of camera very successful not only in the Antarctic but in any other climate. Ratchet cranks should be furnished with all Eyemos to make winding easier.

2. Film.

a. Motion picture film (black and white) should be mostly of the Speed 50 group for all outdoor shooting; for indoors, speed 100 is recommended.

b. Color film (movie) 16-mm should be shot only on sunny days, otherwise no color exists in the Antarctic except a dull gray.

c. A better tape or substitute should be used for packing motion picture film in cold weather when currently used tape requires inconvenient heating. Normally, used Army movie film can labels are considered adequate for field use in the Antarctic. A type of seal lock for film cans (similar to those on shoe polish cans) should be devised.

3. Tripods.

a. A geared head tripod like the Akley should be used instead of the Mitchell friction head tripod for the Mitchell camera.

b. Winterized "Ackley" tripods would probably have resisted colder temperatures than the Mitchell tripods.

4. Transportation.

In future expeditions, photographic units should have some means of motor transportation available at all times in order to obtain good coverage.

5. Mitchell Cameras.

a. One thousand foot magazines should be used for the Mitchell to avoid changing film so often.

b. Army photographers should be instructed thoroughly in the best method and rhythm of hand-cranking the Mitchell in the event that they might be called upon to do so in an emergency.

c. Mitchell winterized cameras should be used 100 percent in an operation like this according to TB SIG 189. Coated lenses would prevent glare. Covers for cameras which are not in use but outdoors should be made available, preventing snow on lenses, motors, magazines, and over-all equipment. Preferably it should be a light and non-stiffening and waterproof cover with a drawstring that could be tied on the tripods to be

always ready for use. The Mitchell cameras both Hi-speed and Standard were not properly winterized in accordance with TB SIG 189.

6. View Finders.

a. A new view finder should be designed for the Cine Special to aid in sighting that camera. The present one collects snow easily and gives a great deal of glare and reflection.

b. The turret view finder on the Eyemo should be tightened in cold weather in order to seat properly and avoid "blind" view when shooting movies in a hurry.

7. Cine Special.

a. A Bolex, with its automatic threading mechanism, should be investigated for cold weather work as a possible replacement for the Cine Special.

b. All lenses for the Cine Kodak Special (16-mm) should have neutral density filters, and 200-foot magazines might be usable if long periods of shooting are required.

8. Protective Covers.

a. Protection should be provided on the rear of certain cameras to keep a photographer's face from the metal of the camera.

b. Proper protective coverings for cameras, such as the Mitchell, should be provided to prevent harm to the camera because of the wind and snow so prevalent in the Antarctic. This could be of very simple construction, made from flexible water repellent fabric with a drawstring at the bottom.

c. Protective covers for Graphics and Graflexes are essential. They should be waterproof and windproof, protecting both the camera and the flash gun.

9. Gloves.

Some sort of silk or nylon inner gloves should be provided for all photographers'

hands for use in changing film and operating cameras at low temperatures. These, worn inside woolen mittens covered with their leather shells, should keep a photographer's hands warm.

10. Identification Plates.

On all future joint expeditions, in which Army and Navy photographers participate, typical *small* Army motion picture scene identification plates should be furnished, since painted wood proved unsatisfactory on this operation (fig. 278).

11. Coverage.

Coverage was good. There should be one officer in charge of photography and no more. Each one seems to have a different aspect or view on subjects to be covered and this causes considerable confusion to the photographer, who finds himself in between shooting and not shooting a given subject. All coverage should be made available immediately for shipment back to the United States after shooting, thus making it more valuable for publicity purposes.

12. Speedster Camera.

The Speedster (16-mm, 50-foot autoloader) is not recommended for an operation of this kind where a lot of shooting is done. This camera has a very short wind, making more work for the photographer than necessary.

13. Motors.

Motors should have protective covers against drifting snow and cold to prevent them from freezing or slowing down.



Figure 278. Mitchell camera shooting identification plates.

14. Batteries.

Batteries should be as light as possible, preferably aircraft batteries, with good waterproof protective covers when near sea water and a damage-resistant case to protect against hard usage. The Army 12-volt aircraft battery is recommended.

15. Exposure Meters.

Precautions should be taken to assure accuracy of the meter, especially when used in intense sunlight, since photoelectric cells may go bad and give a faulty reading.

SECTION VII. Comments by U.S.N. Observer

The following are remarks made on various aspects of photography by Lt. Charles Shirley, U. S. N. R., task force photographic officer.

1. R4D Camera Installations.

We had considerable difficulty in the R4D camera installation because the camera ports were not sealed. While attempting to load aerial magazines in the air some of the photographers' fingers became near frost-bitten.

2. Handling of Film.

Conditions in the Antarctic being relatively dry, there was no chance of moisture accumulating in containers. Therefore, at the Bay of Whales, color film was sealed in ordinary containers. There were no special problems in the transportation of photographic materials or in processing. All processing in the Antarctic was done aboard the ships of the Task Force.

3. Exposure.

There was no trouble in exposure encountered. Exposures were obtained by taking exposure meter readings in the shadow for black and white film. For color film the same method was used except that a close-up reading was made of the subject being photographed.

4. Research.

Tests were made to determine the color temperature of the light in the Antarctic, the results of which will not be known until a later date.

5. Aerial Photographs.

Aerial photographs can be made with any type of aerial camera at any time of day where there is sufficient light for proper exposure. Photographs were made on this expedition and the previous expedition with the sun appearing at the top of the photograph with good surface detail in the photograph, except for a little halation which is normal in any photograph of this type. Experience on this expedition and the last Antarctic expedition indicated that an average of about 10 days per month may be depended upon for good flying photographic days.

6. Effects of Temperature.

In general, the cameras on this expedition failed at much warmer temperatures than they did on previous Antarctic expeditions. It is believed this was caused by inferior workmanship. There were several failures of aerial cameras, believed due to new cameras' being too tight. It was observed that all the old well worn cameras worked perfectly. All cameras were relubricated with several different low-temperature oils and lubricants.

METEOROLOGY

SECTION I. Meteorological Plan

1. Sources of Meteorological Information and Data.

a. Weather Centrals. (1) The major meteorological unit of each task group to act as weather central for that group after reaching the operational area, 55° south latitude.

(2) Weather centrals to relay weather data from their group to the other groups and to the base camp, when established.

(3) Weather centrals and the base camp to issue daily 24-hour forecasts and special route forecasts for all anticipated flights.

b. Surface Observations. (1) The major meteorological unit of each group to furnish 3-hourly surface synoptic reports. The base camp, when established, and the automatic weather station, when operative, to furnish 3-hourly surface synoptic reports.

(2) One other meteorological unit of each group to furnish 3-hourly surface synoptic reports when *not* in company with units indicated in (1) above.

(3) The remaining meteorological units of each group to furnish 6-hourly surface synoptic reports when *not* in company with units indicated in (1) and (2) above.

c. Upper Air Observations. Certain meteorological units from each group to furnish two each rawin, pibal, and raob observations daily.

d. Inflight/Postflight Reports. Weather centrals to interchange weather reports from flights made by reconnaissance planes.

e. Weather Reports from Outside Sources. All available outside sources of weather data

such as whalers and fixed stations in Tasmania, Argentina, and Chile to be used.

2. Distribution of Meteorological Personnel.

a. Meteorological personnel available, including staff and ship complements, to be distributed among the ships of the task force in accordance with the weather services to be furnished.

b. The observers from the U. S. Weather Bureau and from the U. S. Army Air Forces, Air Weather Service, to remain on the U. S. S. *Mount Olympus* throughout the operation.

3. Radar and Radio Meteorological Program.

a. Photographs of any weather phenomena observed on the scopes of radar sets installed on the U. S. S. *Mount Olympus* and/or the U. S. C. G. C. *Northwind* to be taken at significant intervals. Each series of photographs will indicate the time and date of occurrence with a brief description of the weather conditions existing.

b. A daily program of low-level meteorological soundings to be made by the meteorological unit of the U. S. S. *Currituck*, and from aircraft when available for this project, in cooperation with the Naval Electronics Laboratory Radar and Radio Propagation Program.

4. Transmission of Weather Reports.

a. Normal weather reports to be given *priority* designations.

b. Reports which indicate weather changes to adverse conditions to be given *operational priority* designations.

5. Hand Punch Card Program.

All surface, rawin, pibal, and raob weather observations to be entered on the WBAN punch cards with the hand punch machines.

6. Equipment and Supplies.

a. Equipment and supplies for a 4-month period of operation to be furnished each meteorological unit.

b. Spare bulky supplies, such as helium and radio-sonde transmitters, to be carried aboard the tankers and the cargo ships and transferred to using ships as required.

7. Amendments to Original Operational Plans.

a. Due to unexpected ice conditions in the Ross Sea which indicated that the unpro-

tected ships of the Central Group should be north of the ice pack prior to the middle of February, it was planned that the U. S. C. G. C. *Northwind*, assisted by the U. S. S. *Burton Island*, would escort the U. S. S. *Mount Olympus*, U. S. S. *Yancey*, and U. S. S. *Merrick* through the ice pack and return to the base camp via McMurdo Sound. Until the base camp was evacuated, the U. S. S. *Mount Olympus* would forward surface synoptic weather reports from the vicinity of Scott Island, the U. S. S. *Merrick* from the vicinity of the Balleny Islands, and the U. S. S. *Yancey* from midway between Scott Island and the Balleny Islands.

b. During the operation of the base camp, a trail party, to test various items of matériel, was sent out to establish a temporary camp eastward of the base camp. This party was equipped and instructed to furnish surface weather observations as required.

SECTION II. Technical Observations

1. The Weather Station.

The weather station ashore, Little America IV, was located near the northern corner of the base camp and was adjacent to the airstrip. It was in a pyramidal tent and, with the photographic, medical, and dental tents, the pilots' ready room (tent), and the operations building (Quonset-type hut), formed the L-shaped area shown in the left center of figure 27. Figure 279 is another view of the pilots' ready room. The weather station is shown in detail in figure 280 with a locally constructed doorway, an ice wall partially completed about the tent with the balloon inflation shelter and the helium bottles to the right. The instrument shelter, figure 282, and the anemometer, figure 281, were erected northeast of the station.

2. Briefing of Pilots.

Pilots were briefed and debriefed in the operations building, a Quonset-type hut located near the weather station. Figure 283 illustrates a pilot being briefed on weather conditions expected en route; figure 284, Admiral Byrd briefing an aircrew prior to an exploratory flight; and figure 285, Admiral Byrd, Commander Hawkes, and Commander Campbell plotting new discoveries.

3. Weather Centrals.

a. The meteorological units of the U. S. S. *Mount Olympus*, the U. S. S. *Pine Island*, the U. S. S. *Currituck*, and after departure of the Central Group from the vicinity of the base camp, the base camp acted as weather cen-



Figure 279. Admiral Byrd, Dr. Siple, and pilot entering pilots' "ready room" for flight briefing.



Figure 280. The weather station. Note balloon inflation shelter and helium bottles to the right.



Figure 281. The anemometer.

trials for the Central Group, Eastern Group, Western Group and base camp, respectively.

b. The weather centrals relayed the weather data of their groups to other groups and the weather central of the Central Group relayed weather data to the base camp.

c. The weather centrals issued a daily 24-hour forecast and special route forecasts for all anticipated flights. The U. S. S. *Mount Olympus* weather central also furnished daily operational forecasts for all groups to the Commander, Task Force Sixty-Eight, and additional special forecasts as required.

4. Surface Observations.

a. Three-hourly surface synoptic observations were interchanged between the U. S. S. *Mount Olympus*, U. S. S. *Pine Island*, U. S. S. *Currituck*, and the base camp. Due to the lateness in arrival of the Central Group at the base camp and due to the unexpected Ross Sea ice conditions indicating an early departure of the unprotected ships for safety, the project of establishing an automatic weather station at or near McMurdo Sound was abandoned.

b. Three hourly surface synoptic observations were furnished by the U. S. C. G. C. *Northwind*, the U. S. S. *Brownson*, and the U. S. S. *Henderson* when not in company with the U. S. S. *Mount Olympus*, the U. S. S. *Pine Island*, and/or the U. S. S. *Currituck* and when not in the vicinity of the base camp. The U. S. S. *Phillipine Sea* forwarded 3-hourly surface synoptic observations to the U. S. S. *Mount Olympus* while within the operational range of the base camp.

c. Six-hourly surface synoptic observations were furnished by the U. S. S. *Burton Island* after arrival within operational range of the base camp and when not in company with the Central Group; and by the U. S. S. *Canisteo* and the U. S. S. *Cacapon* when not in company with other ships of their group. The U. S. S. *Sennet*, after penetrating a short



Figure 282. The instrument shelter.

distance into the ice pack, was escorted to Scott Island by the U. S. C. G. C. *Northwind* and furnished 6-hourly surface synoptic observations until no longer required for the operation of the Central Group. The U. S. S. *Merrick* and the U. S. S. *Yancey* remained in company with either the U. S. S. *Mount Olympus* or the U. S. C. G. C. *Northwind* while within operational range of the Central Group and did not furnish any weather observations. As directed by the Chief of Naval Operations, the meteorological unit of the U. S. S. *Mount Olympus* began 21 December 1946 forwarding 6-hourly surface synoptic reports to the weather services of Chile and Argentina and continued until reaching the operational area.

5. Upper Air Observations.

a. Two daily pibal observations beginning 210000Z December 1946 and two daily raob

observations beginning 210600Z January 1947 were taken from the U. S. S. *Mount Olympus* and continued until the ending of the operations at the base camp. Reports of the pibal observations, until reaching the operational area, were forwarded to the weather services of Chile and Argentina as directed by the Chief of Naval Operations. Rawin observations were not taken by the Central Group because the required radar set, installed on the U. S. S. *Mount Olympus*, was inoperative throughout the operation.

b. Two daily raob observations were taken from the U. S. C. G. C. *Northwind* from entry into the operational area until this function was assumed by the meteorological unit of the U. S. S. *Mount Olympus*.

c. Two each daily raob and pibal observations were taken from the U. S. S. *Pine Island* and the U. S. S. *Currituck* as planned.

d. Two daily rawin observations were taken from the U. S. S. *Brownson* and the U. S. S. *Henderson* as planned.

6. Inflight/Postflight Reports.

a. Reports from flights made by the base camp reconnaissance planes were forwarded to the Eastern and Western Groups from the U. S. S. *Mount Olympus* as available, as planned.



Figure 283. Briefing pilot on expected weather conditions.

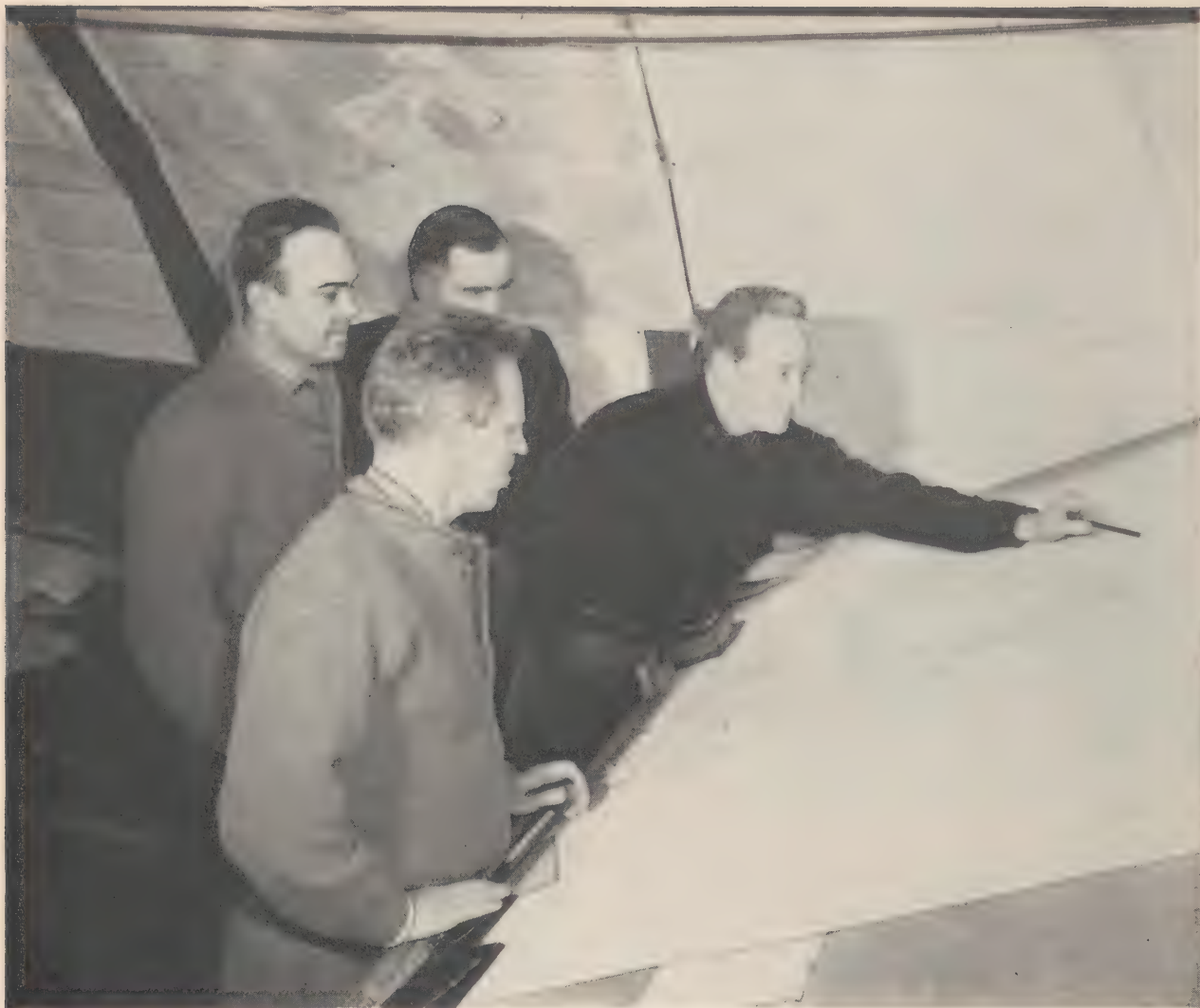


Figure 284. Admiral Byrd briefing aircrew prior to exploratory flight.

b. Reports from flights made by the Eastern Group reconnaissance planes were forwarded to the other groups and to the base camp from the U. S. S. *Pine Island* as available, as planned.

c. Reports from flights made by the Western Group reconnaissance planes were forwarded to the other groups and to the base camp from the U. S. S. *Currituck* as available, as planned.

d. The inflight/postflight reports received by the Central Group were incomplete and indicated a lack of familiarity of the aircrew

members with weather observing and with the encoding and the transmission of weather data.

7. Weather Reports from Outside Sources.

a. En route to the operational area, weather data was intercepted by the U. S. S. *Mount Olympus* as broadcast from Washington, D. C., New Orleans, Louisiana, Coco Solo, C. Z., Brazil, Bolivia, and Chile. Within the operational area, except as indicated in *b* below, no weather reports were received by the Central Group from

outside sources. En route to the United States via New Zealand from the operational area, weather data was intercepted by the U. S. C. G. C. *Northwind* from New Zealand, enabling that ship to avoid a storm center while towing the U. S. S. *Merrick*; weather data was intercepted by the U. S. S. *Mount Olympus* similar to that intercepted en route to the operational area.

b. Beginning 26 December 1946, 6-hourly surface synoptic reports were received by the Western Group, and relayed to the other groups, from two Japanese whalers operating in the vicinity of 70° south latitude and 170° east longitude. The Western Group intercepted weather data as broadcast from New Zealand, Australia, and Africa but the Antarctic analyses included therein were not found to be satisfactory.

c. The Eastern Group intercepted weather data as broadcast from South America and the Falkland Islands which included reports from two weather stations established by the British in the Palmer Peninsula.

8. Personnel Assignments.

a. Meteorological personnel available, including staff and ships' complements, during most of the operating time and while in the operational area, were assigned as follows:

(1) U. S. S. *Mount Olympus*. 1 CAerM, 1 AerM2, 1 AerM3, 4 seamen(AerM).

(2) U. S. C. G. C. *Northwind*. 1 Lt. Comdr., 1 CAerM, 1 AerM3, 2 seamen (AerM).

(3) U. S. S. *Sennet*. None, the weather observations on this ship being taken by the ship's quartermaster, an assistant to the navigator.

(4) U. S. S. *Yancey*. Although it was originally planned that no meteorological personnel would be aboard this ship, during part of the operation (see par. 7a, sec. I), the following were assigned to the U. S. S. *Yancey* and were aboard that ship from the

base camp until reaching Dunedin, New Zealand: 1 AerM3, 2 seamen(AerM).

(5) U. S. S. *Merrick*. Although it was originally planned that no meteorological personnel would be aboard this ship, during part of the operation (see par. 7a, sec. I), the following were assigned to the U. S. S. *Merrick* and were aboard that ship from the base camp to Scott Island and there transferred to the U. S. C. G. C. *Northwind* to continue to Dunedin, New Zealand. 1 AerM3, 2 seamen (AerM).

(6) U. S. S. *Burton Island*. 1 AerM2.

(7) U. S. S. *Pine Island*. 1 Lt. Comdr., 1 Lt. (jg), 1 CAerM, 1 AerM1, 2 AerM2, 4 seamen (AerM).

(8) U. S. S. *Brownson*. 1 AerM1, 1 seaman (AerM).

(9) U. S. S. *Canisteo*. 1 CAerM, 1 seaman (AerM).

(10) U. S. S. *Currituck*. 2 Lieut., 1 CAerM, 2 AerM1, 1 AerM2, 4 seamen (AerM).

(11) U. S. S. *Henderson*. 1 AerM1, 1 seaman (AerM).

(12) U. S. S. *Cacapon*. 1 AerM2.

(13) *Base Camp*. 1 Captain, 1 CAerM, 3 AerM2, 1 AerM3.



Figure 285. Admiral Byrd, Commander Hawkes, and Commander Campbell plotting new discoveries.

b. The two non-Navy meteorological observers were assigned as follows:

(1) *U. S. Weather Bureau Observer*. From Norfolk, Virginia, to Little America IV, aboard the U. S. S. *Mount Olympus*. Ashore Little America IV until the base camp was evacuated. From Little America IV to West Coast, U. S. A., aboard the U. S. S. *Burton Island*.

(2) *U. S. A. A. F., Air Weather Service Observer*. From Norfolk, Virginia, to Little America IV, aboard the U. S. S. *Mount Olympus*. Ashore Little America IV until departure of Central Group ships. From Little America IV to Scott Island, aboard the U. S. S. *Merrick*. From Scott Island to Dunedin, New Zealand, aboard the U. S. C. G. C. *Northwind*. While at Dunedin, New Zealand, aboard U. S. S. *Yancey*. From Dunedin to Wellington, New Zealand, aboard the U. S. S. *Burton Island*. From Wellington, New Zealand, to Washington, D. C., aboard the U. S. S. *Mount Olympus*.

9. Radar and Radio Meteorological Program.

a. *SK-2, SG-1C, SP, and SQ Radar*. (1) En route to the operational area, no photographs of weather phenomena observed on the scopes of the radar sets listed above, installed on the U. S. S. *Mount Olympus*, were made as the radar camera was not received until reaching Panama and was not installed before reaching the South Temperate Zone. Therefore, it was unavailable for photographing the shower activity encountered in the tropical regions.

(2) Within the operational area no weather phenomena were observed on these scopes.

(3) Returning to the United States, photographs were made of the scopes showing isolated showers and the line of shower activity along the Intra-Tropical Front.

b. "*Cindy*" (CXJG) Radar. (1) En route to the operational area, photographs of the

scope of the "*Cindy*" (CXJG) radar set, installed on the U. S. C. G. C. *Northwind*, showing a fog bank and others showing isolated showers were made.

(2) Within the operational area no weather phenomena were observed on this radar set.

c. *Low-Level Sounding*. A low-level meteorological sounding program, using standard radiosonde equipment and supplies, was made from the U. S. S. *Currituck* as planned. The balloons were held captive by a nylon one-eighth inch thick cord mounted on a hand reel. The soundings were satisfactorily conducted to heights of 1,000 feet when the ship was not in motion. Airplane observations were also made using a helicopter and a standard aerograph.

10. Transmission of Weather Reports.

a. Normal weather reports were given *priority* designations and, except as indicated in *d* below, were transmitted in *clear* text.

b. Reports indicating weather changes to adverse conditions were given *operational priority* designations and, except as indicated in *d* below, were transmitted in *clear* text.

c. All weather reports were interchanged as "non-scheduled" messages and were delivered, in most cases, in ample time to be used.

d. Weather reports were transmitted using the standard codes outlined in "Radio Weather Aids", H. O. 206. All reports from the Central Group were in *clear* text but those from the Eastern and the Western Groups omitted all indications of position, such locations being obtained from other, confidential, messages. Thus the locations of the Eastern and the Western Groups were kept classified as directed by the Chief of Naval Operations.

11. Hand Punch Card Program.

a. All surface, rawin, pibal and raob weather observations were entered on the

WBAN punch cards with hand punch machines as soon as practicable after each observation was made.

b. The WBAN punch cards were assembled at Task Force Sixty-Eight Headquarters, Washington, D. C., and forwarded for tabulation and filing to the WBAN Punch Card Library, New Orleans, Louisiana.

12. Equipment and Supplies.

a. A 4-month period of equipment and supplies was furnished to each meteorological unit, the meteorological officer or senior enlisted man being responsible for checking the matériel received and obtaining any additional equipment and/or supplies needed from an aerological supply pool prior to departure from the United States. Except as indicated immediately below, the equipment and supplies, all standard items, were apparently satisfactory.

(1) No mercurial barometers were supplied to the meteorological units of the Central Group. However, all aneroid barometers used were adjusted to show similar values.

(2) Some equipment and supplies were lost in a crevasse during the unloading operations but were replaced from surplus items from meteorological units of the Central Group ships.

(3) The Thermo Screen (USAAF nomenclature—Instrument Shelter) mounted on the U. S. S. *Mount Olympus* was found to be defective. The lock on the door, probably due to the swelling of incompletely cured wood used in the original construction,

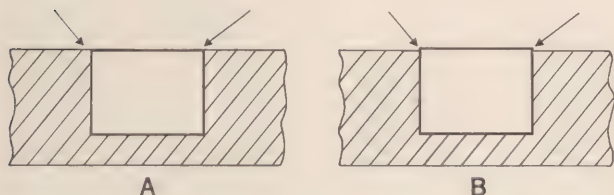


Figure 286. Normal (A) and defective (B) positions of lock on instrument shelter door.

protruded to such an extent that the door would not shut tightly. Figure 286 shows the lock in normal position in relation to the edge of the door (A) and how the lock of this shelter protruded (B).

b. Spare bulky supplies such as helium and radiosonde transmitters were carried aboard the tankers and the cargo ships and then



Figure 287. Logging data in weather station. Note improvised furniture and "false roof" of radar balloon targets.

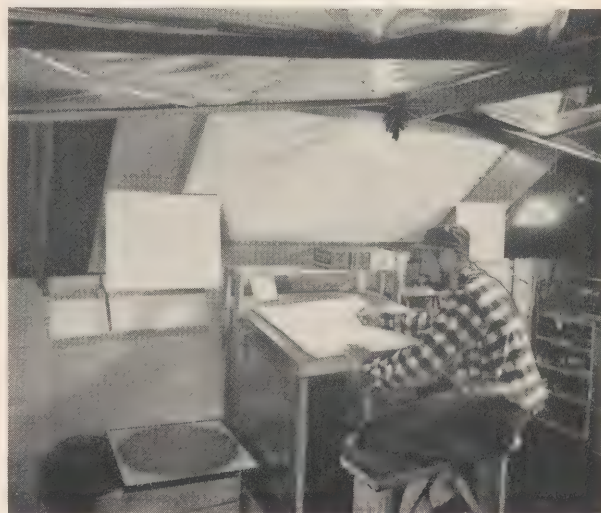


Figure 288. Checking weather direction charts. Note improvised furniture and "false roof."



Figure 289. Spray ice, as found in the North Atlantic Ocean during winter months, formed on the U. S. S. *Burton Island* during a storm while the ship was en route to Little America IV.

transferred to the using ships as required. The helium bottle used by the U. S. Navy is similar to the hydrogen tank used by the U. S. Army Air Forces and is just as heavy and as awkward to handle.

c. All furniture for the base camp was built by using personnel from used packing boxes and plywood stock. Figures 287 and 288 show some of the furniture constructed for the weather station ashore and also show the "false roof" made of radar balloon targets which kept the heat in the lower half of the tent. Standard instrument shelter and anemometer supports are not easily adaptable to installation on an ice surface and special supports were improvised.

d. Much equipment and many supplies can

easily be lost in a snowstorm unless properly marked with sticks that will stick up out of drifting snow.^f The drifts shown in figure 29 were formed in approximately 2 hours during a period of falling and drifting snow, and completely covered at least one box which was 3 by 3 by 5 feet.

13. Amendments to Original Operational Plans.

a. The plan to establish the U. S. S. *Mount Olympus*, the U. S. S. *Yancey*, and the U. S. S. *Merrick* as semi-fixed weather reporting stations north of the ice pack was abandoned when the rudder of the U. S. S. *Merrick* was carried away while traversing the ice pack. The U. S. S. *Mount Olympus* remained in the vicinity of Scott Island, forwarding surface weather reports to the base camp, until the base camp was evacuated. The U. S. C. G. C. *Northwind*, in company with the U. S. S. *Yancey*, towed the U. S. S. *Merrick* to Dunedin, New Zealand, for repairs. The U. S. S. *Burton Island* returned to the base camp to evacuate those personnel remaining there.

b. A temporary camp was established by a trail party at a point approximately 120 miles, bearing 80° true from Little America IV. Surface weather observations were made and reports forwarded to the base camp. The following items of meteorological equipment and supplies were furnished the trail party for making the weather observations:

- (1) Portable anemometer.
- (2) Sling psychrometer with wooden case.
- (3) U. S. W. B. Circular S, Cloud Forms.
- (4) U. S. W. B. Circular 235, Psychrometric Tables.

SECTION III. Weather Processes Encountered

1. Observations Available.

During this operation, the observations of the following groups were available to the meteorological sections:

a. The Central Group operating in the vicinity of the Bay of Whales, Scott Island, and in the Ross Sea.

b. The Eastern Group operating around the Antarctic eastward from the Ross Sea.

c. The Western Group operating around the Antarctic westward from the Ross Sea.

d. The base camp established ashore at Little America IV.

e. Weather data intercepted from Japanese whalers operating in the vicinity of Balleny Islands and from southern Tasmania and New Zealand.

2. Synoptic Charts.

Using the weather reports obtained as indicated above, at least two surface synoptic charts were constructed daily which contained more weather data than any others previously constructed. Three series of these synoptic charts, showing typical situations encountered during this operation, are shown in figures 290 through 311.

3. Frontal Systems.

Similarity between the frontal systems encountered, as shown on the inclosed charts, and those existing in northern latitudes was noticed. Most differences were attributed to the differences existing in land-water area relationships. The Ross Sea is a large water area bounded on the north by the ice pack, on the east by the high mountains of Marie Byrd Land, on the south by the flat Ross Sea Ice Shelf, and on the west by the high mountains of Victoria Land. The Ross Sea, this season, seemed to be a smaller area

than normally encountered, the ice pack being thicker and extending farther south than has previously been reported.

4. Pressure Cells.

Current day textbooks, using only the meager reports that have previously been available, indicate a simple high pressure cell located at the surface of the Antarctic covering most of the continent and a procession of cyclonic activity remaining in about the same latitude moving eastward about the Antarctic Continent. The charts enclosed indicate a persistency of high pressure ridges along the 120° east and the 120° west meridians which may be—

a. Protrusions from a high pressure cell located over the south polar area with a similar extension at 0° longitude, or—

b. Two distinct cells, a third at 0° longitude with a col or low over the polar area, or—

c. An unusual circumstance of the polar cap of high pressure extending farther northward.

5. Antarctic Polar Front.

A primary frontal system, the Antarctic Polar Front, extended along 60° south latitude, the boundary between the cold, dry air of the polar cap and the cool, moist air from the water areas. Wave disturbances occurred along this front as along the Arctic Polar Front. Many of these waves became unstable and developed long occluded systems, the low at the tip moving southeastward while the front moved eastward toward areas where frontolysis occurred against the high cells mentioned in paragraph 4. The speeds of fronts and the wave lengths were very similar to those encountered on the Arctic Polar Front.

SECTION IV. Recommendations

1. Weather Centrals.

The basic plan for the establishment of a weather central for each operational group and/or section is satisfactory.

2. Surface Observations.

a. It is recommended that "6-hourly surface synoptic observations", such as shown in the basic plan as outlined in paragraph 1*b* (3) of section I, be reduced so that the longest period of time between observations submitted by any unit is 3 hours, so that a more complete, up-to-date picture of existing weather conditions is available. Further, provisions should be made for the filing of "special" weather observations when adverse weather conditions occur between routine observations.

b. It is recommended that automatic weather stations be established *en route* to the operational area rather than *subsequent* to arrival so that adverse conditions, such as the ice pack in this operation, might not modify and/or cause the abandonment of the project.

3. Upper Air Observations.

The basic plan for making upper air observations *plus* a project to set up a rawinsonde section ashore as soon as practicable after arrival at the base camp is satisfactory. This additional project will permit continuous observations at the base camp even though adverse ice conditions force the supporting ships some distance off shore.

4. Inflight/Postflight Reports.

a. The basic plan for exchanging inflight/postflight weather reports from each reconnaissance plane is satisfactory.

b. It is recommended that all aircraft used by the USAAF in an operation similar to this contain the following weather personnel and equipment at the minimum:

(1) A weather officer as crew member on each flight other than local.

(2) A radio altimeter for determining constant pressure data over water areas.

(3) An airborne psychrometer for determining moisture data in the air.

c. Good, detailed aircraft weather reports, in areas similar to the Antarctic where normal fixed weather reporting installations are not available are absolutely required for efficient and safe aircraft operation.

5. Weather Reports from Outside Sources.

The basic plan for obtaining weather reports from outside sources is satisfactory.

6. Distribution of Meteorological Personnel.

a. The basic plan for the distribution of meteorological personnel is satisfactory.

b. A similar plan for the USAAF, Air Weather Service, would set up types of stations and/or sections for each installation.

7. Radar and Radio Meteorological Program.

The basic plan for the radar and radio meteorological program is satisfactory.

8. Transmission of Weather Reports.

It is believed that the USAAF, Airways and Air Communications Service's handling of weather reports as "scheduled transmissions" and using the *operational priority* designation for "special" weather reports make for a more efficient weather reports collection.

9. Hand Punch Card Program.

The basic plan for entering all weather observations on the WBAN punch cards as soon as practicable after each observation is satisfactory.

10. Equipment and Supplies.

a. The basic plan to furnish, automatically, sufficient equipment and supplies for the expected period of operation is satisfactory.

b. It is recommended that all equipment be checked prior to departure from the United States so that all programs, such as the taking of rawin observations as set forth in paragraph 1*c* of section I, will not be interrupted, as indicated in paragraph 3.

c. It is recommended that items such as office furniture be prefabricated and packed for assembly prior to departure from the United States.

d. It is recommended that special supports for the installation of weather equipment on an ice surface be developed and provided prior to departure from the United States.

e. Meteorological equipment and supplies to be used by trail parties in making surface observations should be assembled and packed prior to leaving the United States. The packages should be as compact and as light as practicable and should contain full instructions to the observers.

f. Except as indicated above, standard meteorological equipment and supplies as issued by the Signal Corps and as used by the Air Weather Service in Arctic areas are satisfactory in an operation of this type.

11. Amendments to Original Operational Plans.

a. In an operation of this type, it would be expected that amendments to the original operational plan would be necessary, but these should be kept to a minimum.

b. The using of cargo ships, after unloading operations are completed, as semi-fixed weather observing stations making surface and upper air observations should be considered in the original plan.

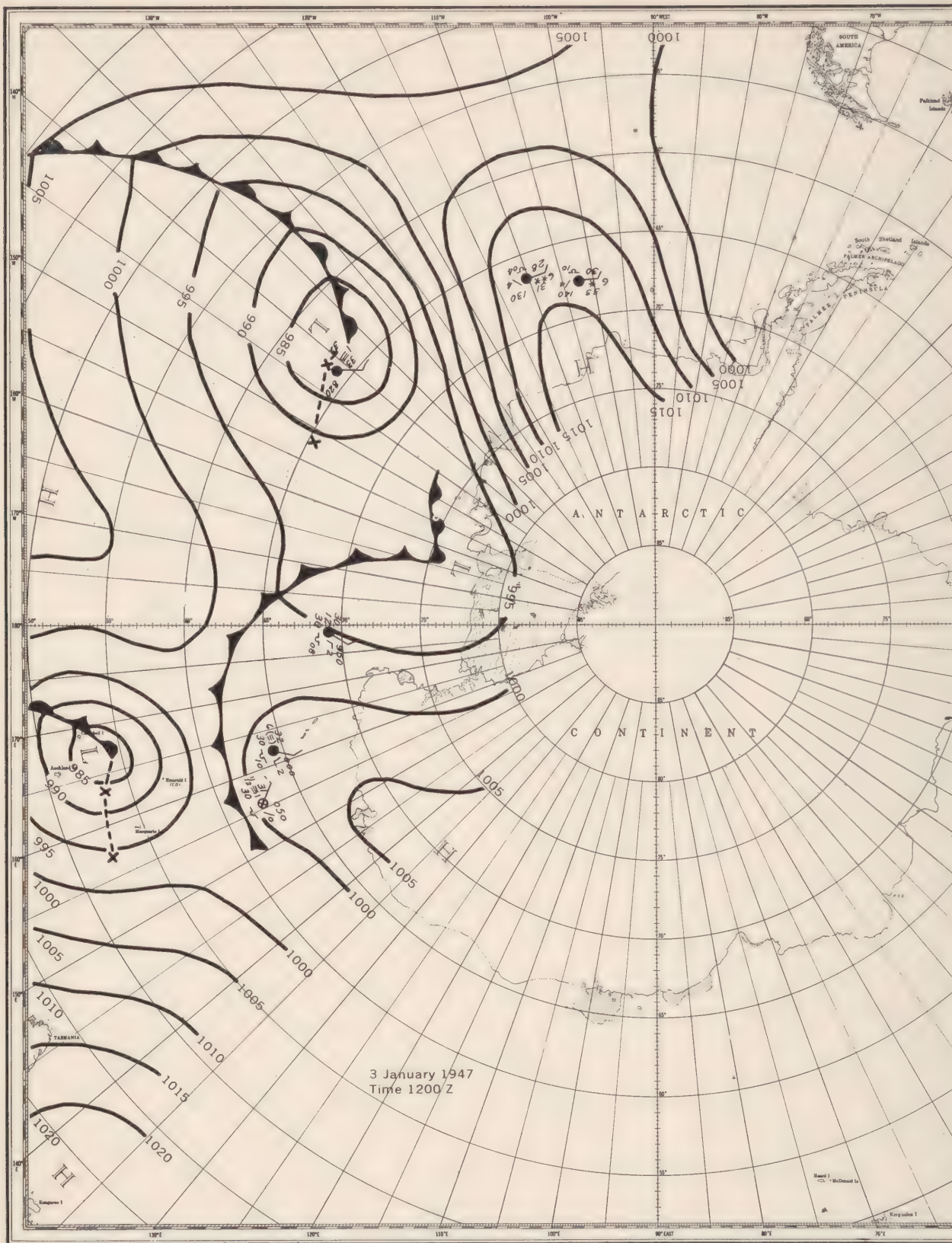


Figure 292. Synoptic chart, 3 January 1947, 1200Z.

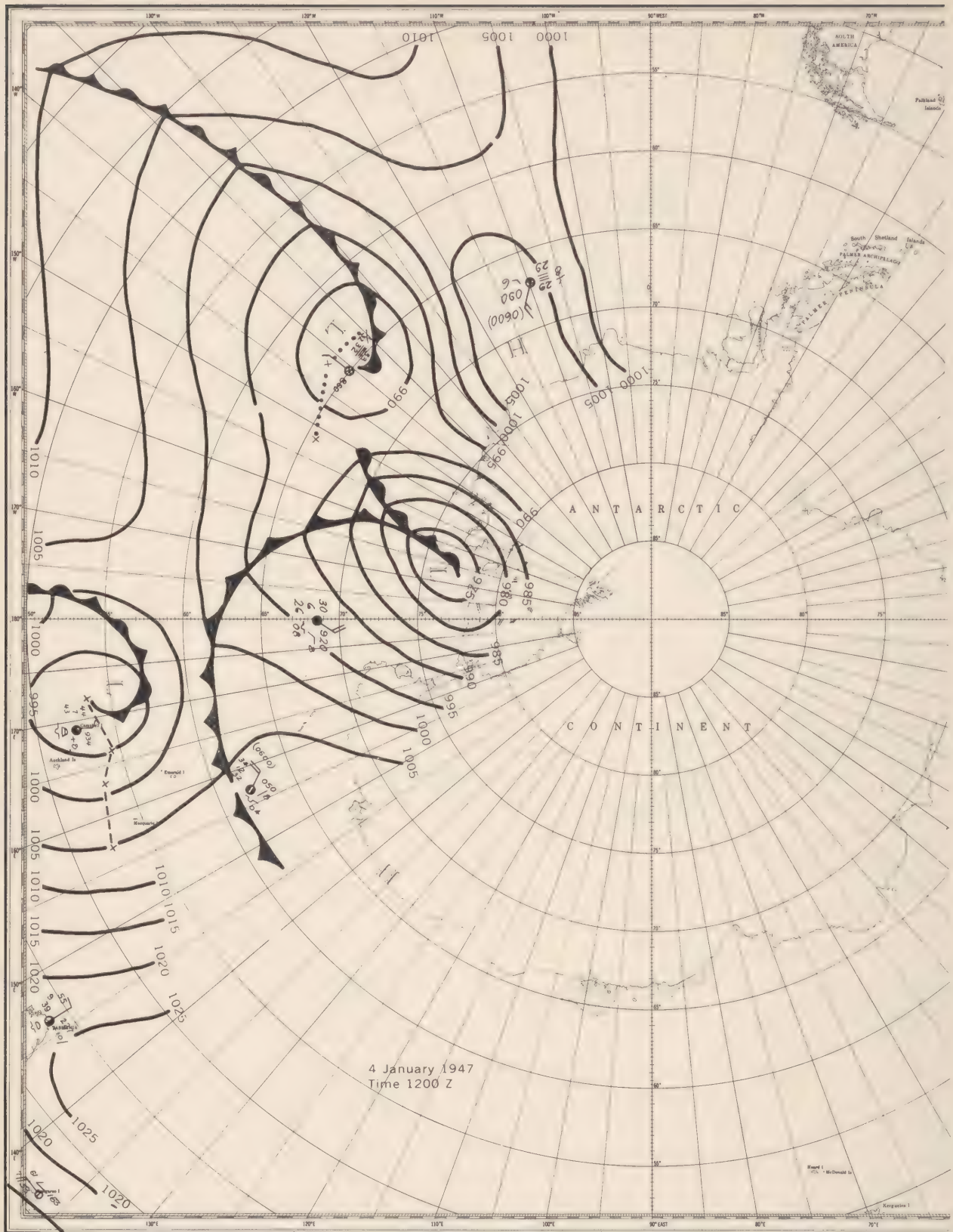


Figure 294. Synoptic chart, 4 January 1947, 1200Z.

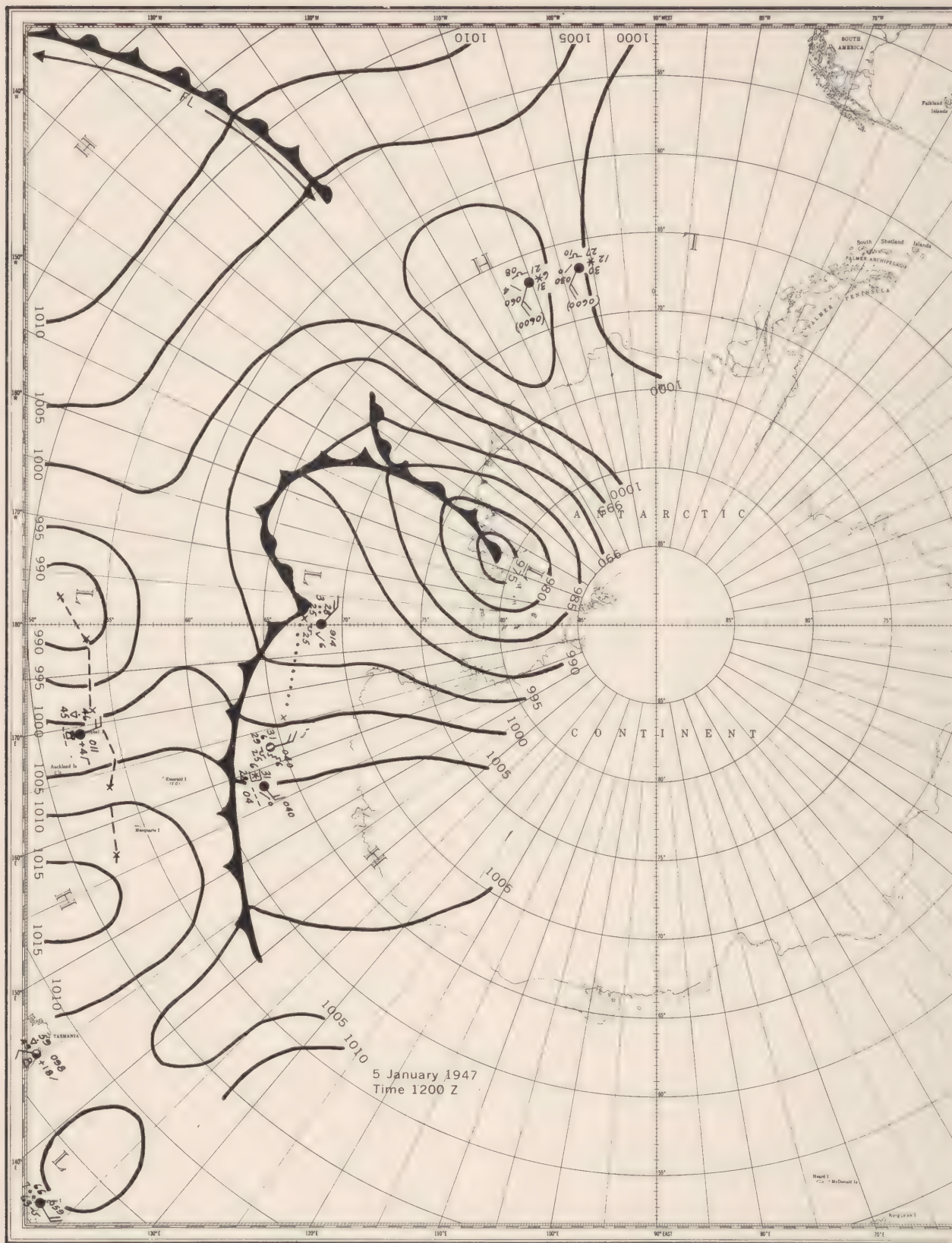


Figure 296. Synoptic chart, 5 January 1947, 1200Z.



Figure 297. Synoptic chart, 6 January 1947, 0000Z.

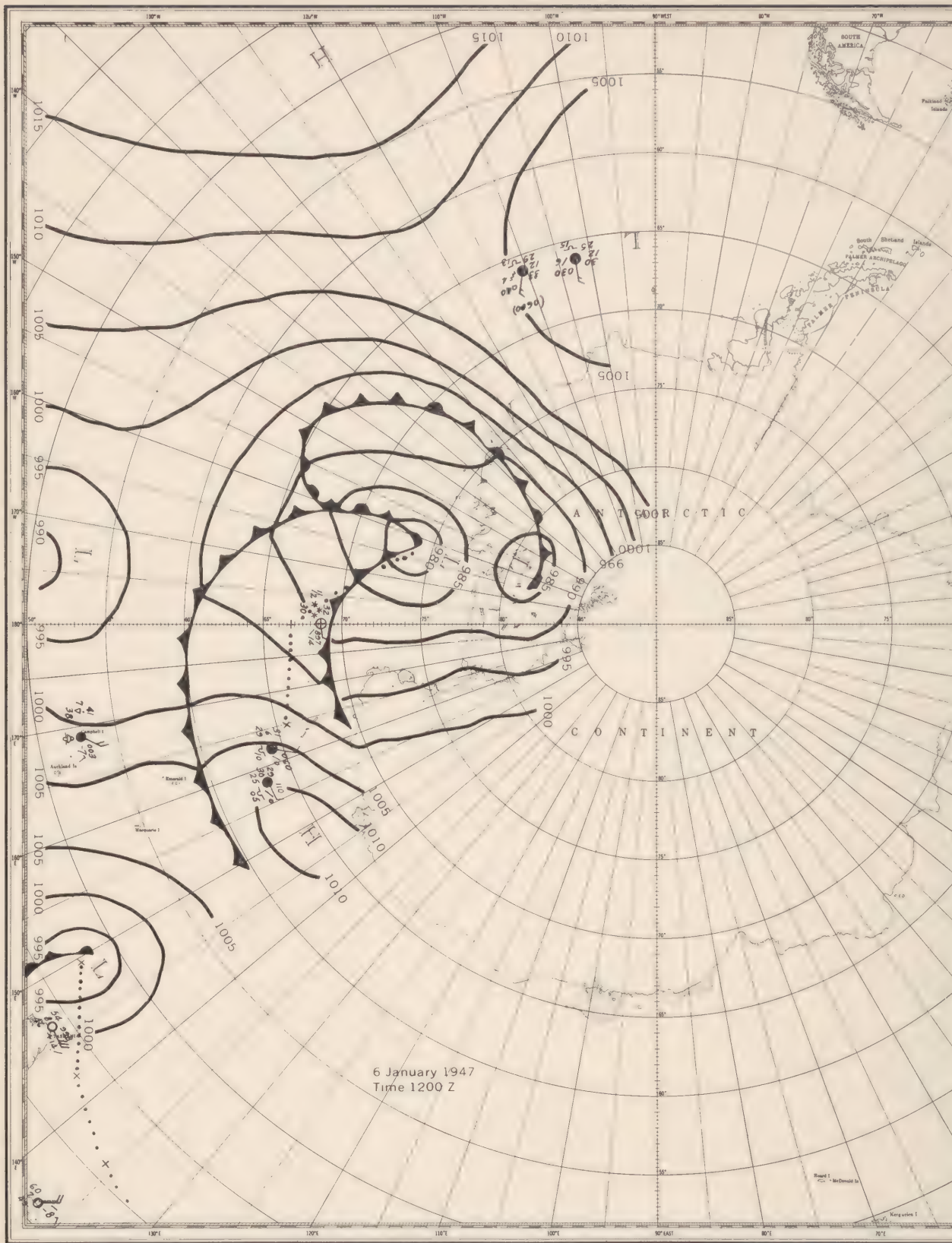


Figure 298. Synoptic chart, 6 January 1947, 1200Z.

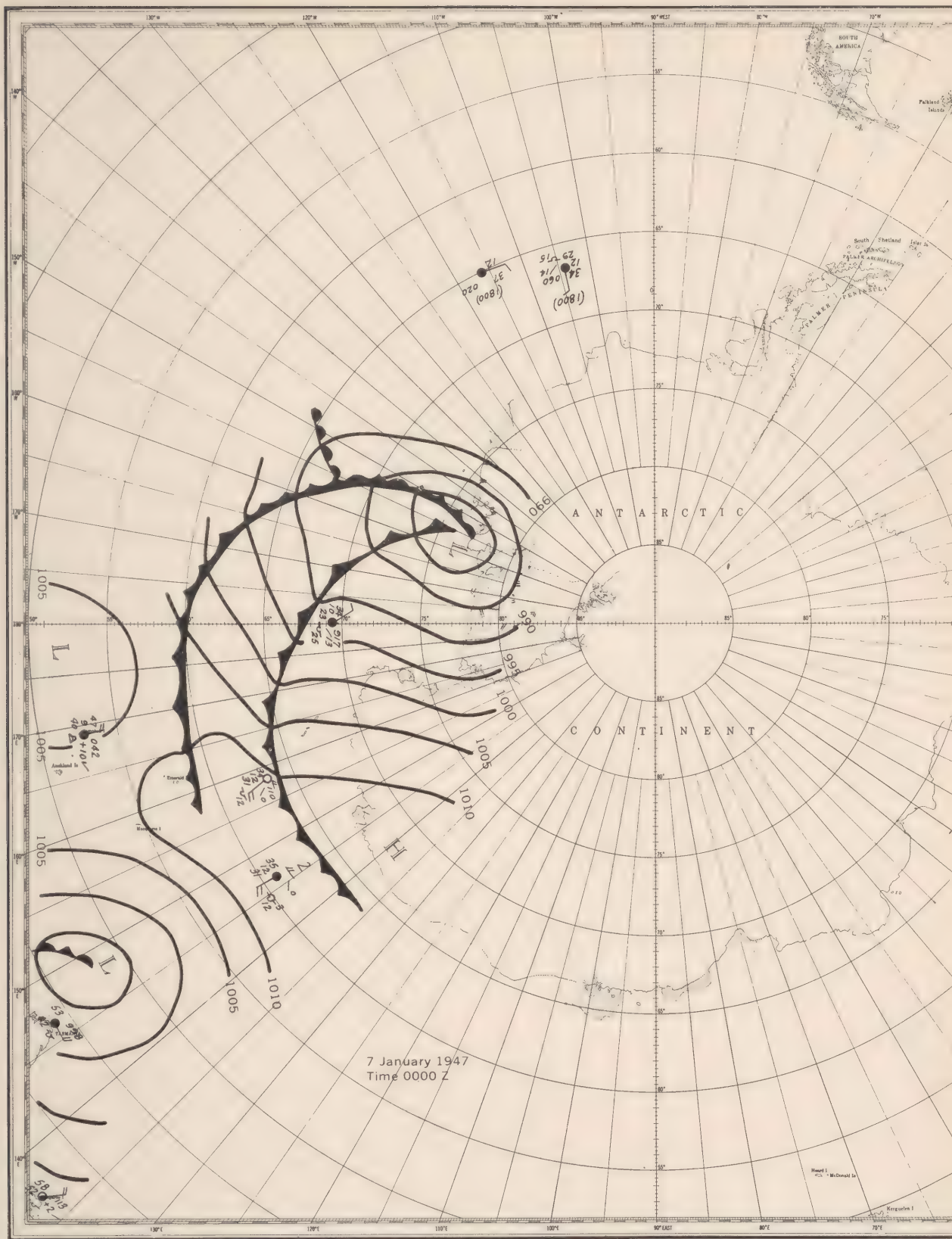


Figure 299. Synoptic chart, 7 January 1947, 0000Z.

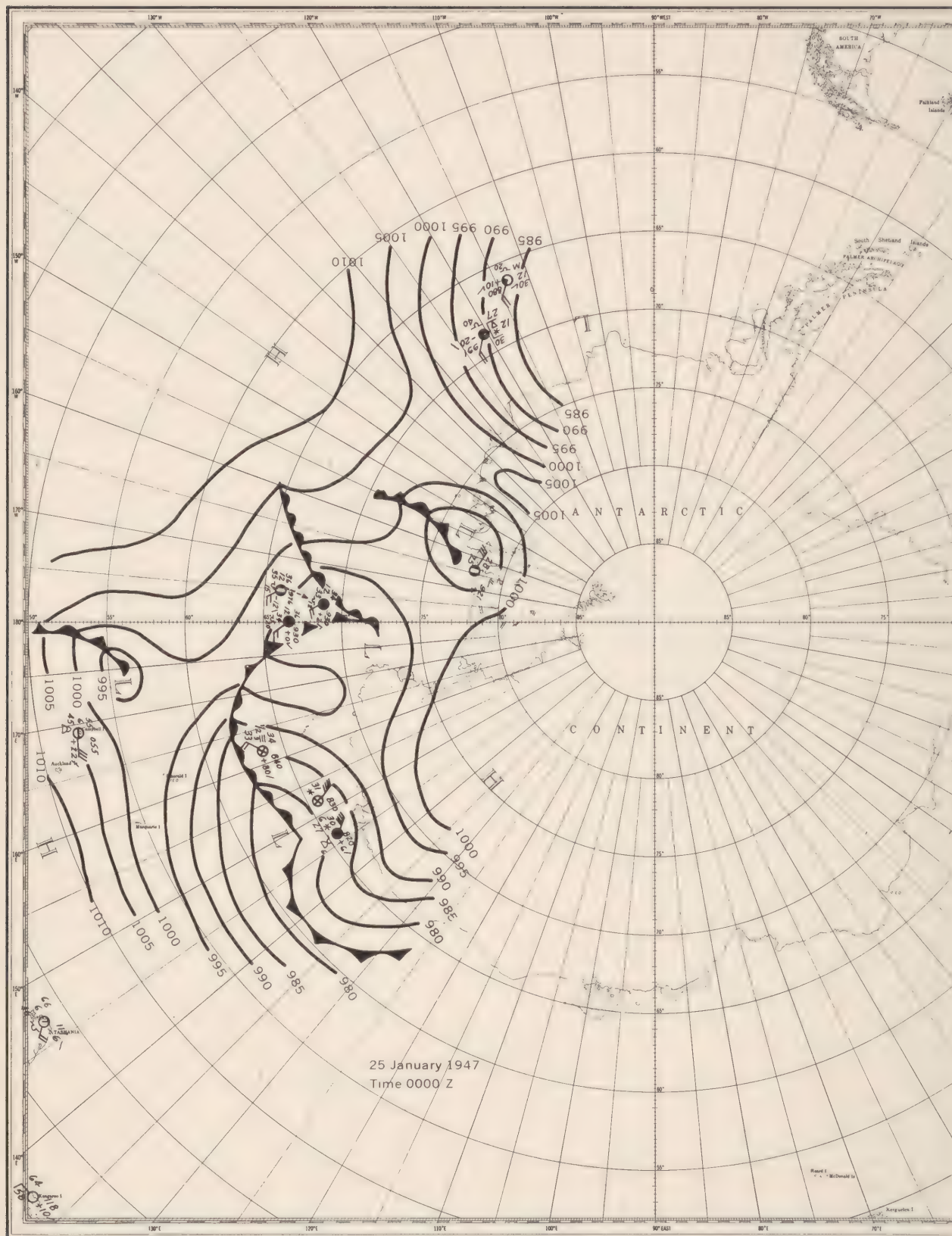


Figure 300. Synoptic chart, 25 January 1947, 0000Z.

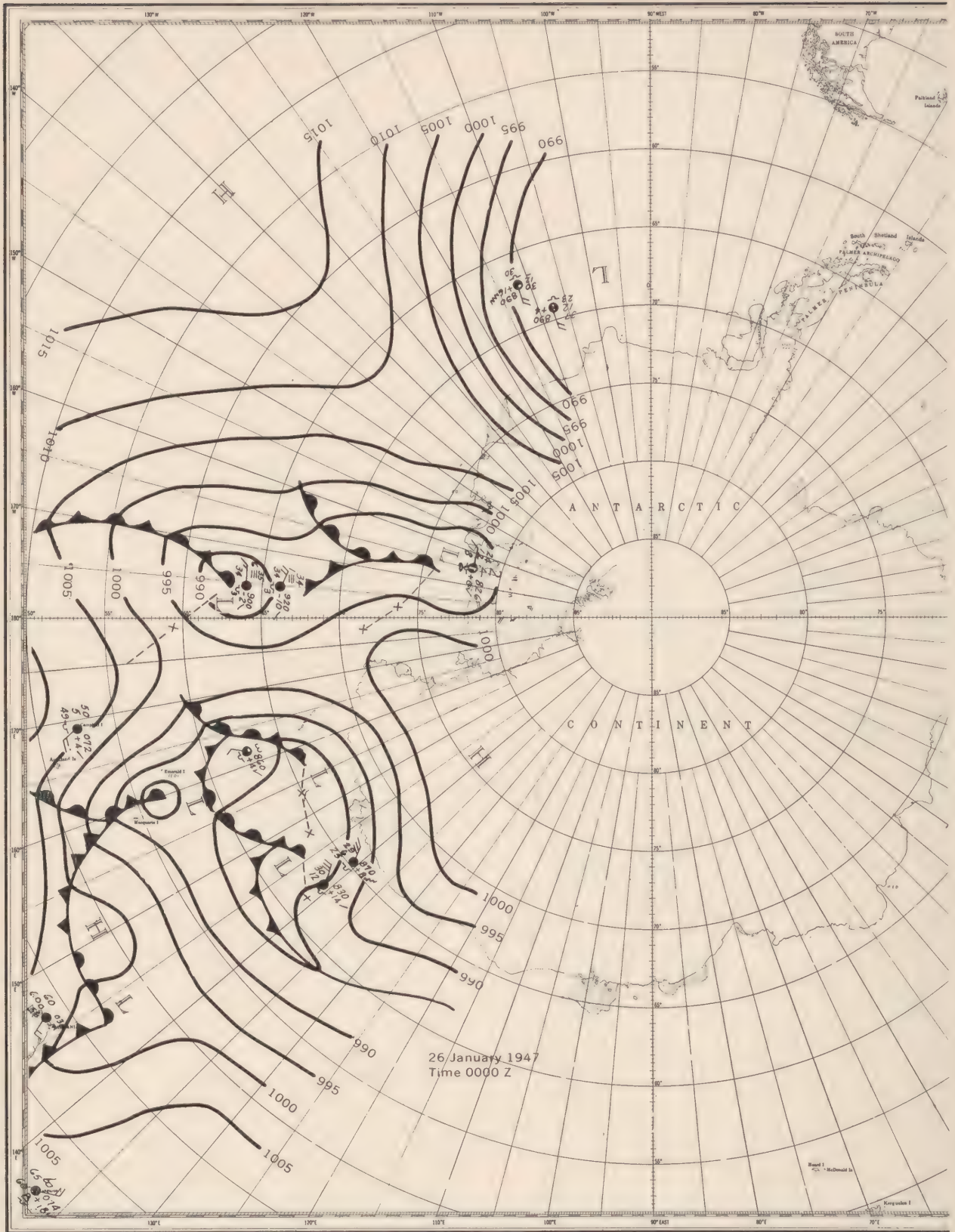


Figure 302. Synoptic chart, 26 January 1947, 0000Z.

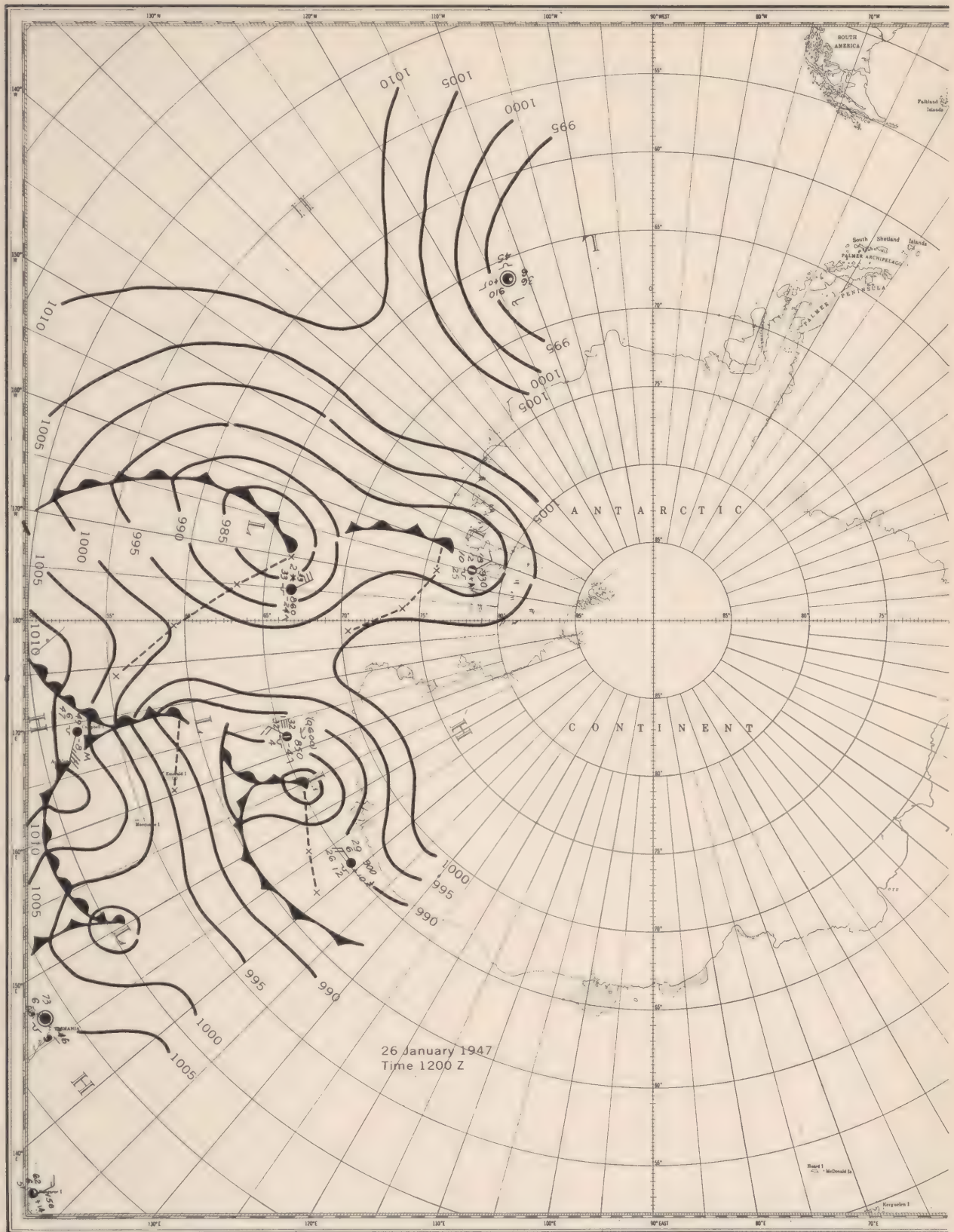


Figure 303. Synoptic chart, 26 January 1947, 1200Z.

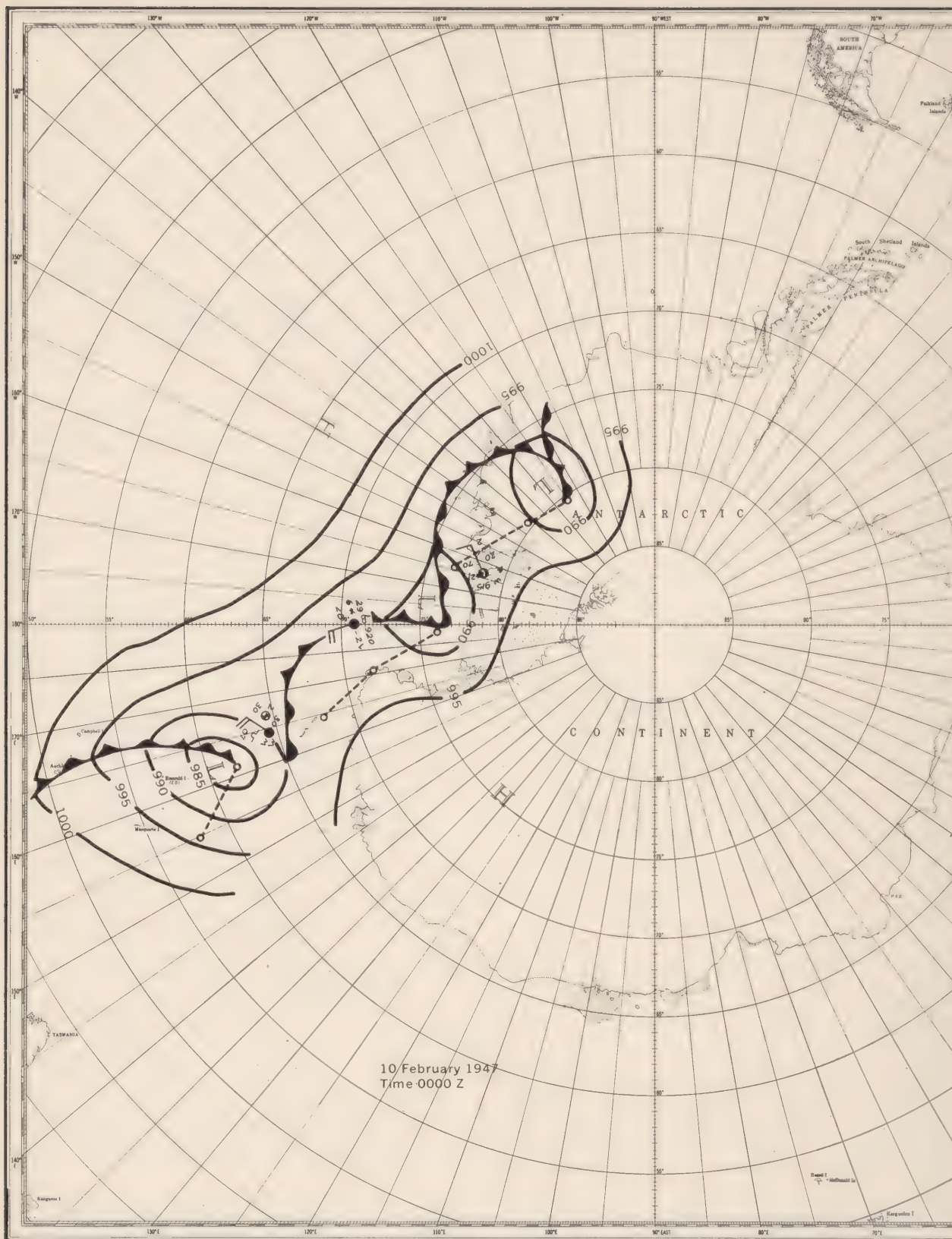


Figure 308. Synoptic chart, 10 February 1947, 0000Z.

ANTARCTIC PLAN FOR SCIENTIFIC EXPLORATION

SECTION I. Approaches to the Antarctic

1. Abstract.

This chapter reviews the importance of the Antarctic as a modern scientific laboratory and points out that the answers hidden in the mysteries to be solved here are important to our present society and to our future military endeavors. During the recent Operation Highjump, and while returning from it by way of New Zealand and Australia, the realization that the Antarctic was important was transposed into three plans for more complete scientific utilization of this finest of natural scientific laboratories.

2. Origin of Plans.

Several new concepts¹ were formulated by the authors during their participation in the operations of project Highjump.² One of the most prominent of these was that the era has been reached in which it is time to cease

¹ The opinions expressed and the plans formulated in this paper are those of the authors and do not necessarily represent those of the Army, the AAF, the United States Navy, or any agency of the United States Government.

² Dr. Paul A. Siple. WDGS, R&D. Dr. Siple is one of the world's recognized foremost experts on the Antarctic, having participated in the three previous Byrd Antarctic expeditions. Dr. Siple was specifically requested by Admiral Byrd to be his advisor on polar matters for this expedition. He was designated senior War Department Observer on Operation Highjump.

Robert N. Davis, Operations Analyst, Strategic Air Command. Widely experienced through the war in airborne radar and in the utilization of scientific equipment for military operations. Requested by Admiral Byrd to be his scientific aide during this expedition.

the classical or adventurous exploration which taught the character and extent of Antarctica and to begin the scientific exploitation of the Continent and its surrounding waters. It is appreciated that this change is due primarily to the advent of the new methods and tools that modern science and engineering have made available and to the requirements of science, engineering, and society. Operation Highjump conclusively demonstrated this change in aspect. Every endeavor pointed to the fact that good work could be accomplished, and that the results were here to be obtained if the proper organization, equipment, methods, and analyses were to be had. The great majority of the things needed are available. They need only to be gathered, organized, and directed, not necessarily by explorers, but by modern science.

Another concept of prominence that grew during the operations was that aircraft, ice breakers, and vehicles were now existent for the rapid, systematic, scientific reconnaissance of the Antarctic. As an example of this, it is pointed out that a few flights by appropriately equipped and manned VLR reconnaissance aircraft based in either New Zealand, Australia, South Africa, or South America could accomplish more in scientific reconnaissance and mapping than all of the previous Antarctic expeditions. In fact, these aircraft could fly from Australia,

map the interior of the continent never before seen by man, and return to Australia. Use of the flight strip on Maquarie Island presently being installed by the Australian Government would bring the entire Antarctic Plateau within the range of currently flying B-29 photo reconnaissance aircraft.

It is pointed out that newly created United States tools, i. e., ice breakers, VLR aircraft, small reliable aircraft, tracked vehicles, and "know-how" can take the isolation away from the Antarctic. The very long range aircraft can take into, and return from, the heretofore remote bases, first rate scientists, the value of whose time is so great as to preclude their remaining in isolation for long periods. The men and equipment can be taken in throughout the entire year, not just during a few frantically rushed summer months. The ability to communicate readily from base to base and from the bases to the "outside" world creates the possibility of "round table" radio coordination for the more complete utilization of ideas and equipment, and for rapid reporting and planning. Coordinated effort between large, long range aircraft and small aircraft makes feasible the rapid exploration of areas previously unexplorable or approachable only through the most tedious and hazardous ground methods. Small aircraft (Army L-5 and L-13 types) have demonstrated their rugged ability to operate from very small areas of rough ice and snow surfaces. And while they have limited range, they can be air-stowed and supplies can be parachuted to them. The combination of large and small aircraft gives great range with the small operating area advantage.

Ground control techniques and mapping methods are now available for the systematic documentation of the features of Antarctic by combined air-ground surveys. This is very important to the tabulation of the mineral wealth and its availability.

A third important concept developed through a series of discussions with the scientists and statesmen of New Zealand and Australia.³ Prominent among these men and agencies were Dr. Marsden, CSIR, and Prime Minister Peter Frazer of New Zealand, Sir Douglas Mawson, Drs. White, Brown, Hooke, and Cotton, and the NRC and DSIR, of Australia. This third concept was that the scientific answers to be gleaned from the Antarctic belonged to the world, and further that these answers could best be obtained by the scientists of the world working together. A good example of the joint effort needed is that of aircraft. The United States has the aircraft; New Zealand and Australia have the bases from which to fly them. New Zealand and Australia have men vitally interested and wise in the ways of the Antarctic; the United States has ice breakers, instruments, and scientific know-how. Real science is an international part of mankind, not the exploitations by any one group of men.

At the time that the before-mentioned discussions were taking place, Great Britain had four bases established in the Falkland Island Dependency. New Zealand was actively planning an expedition to the South Magnetic Polar area to establish magnetic and cosmic ray stations to be maintained through one sunspot cycle (approximately 11 years). Australia was developing equipment and techniques for an expedition to

³ Dr. Siple and Mr. Davis left Little America with the base group aboard the U. S. C. G. C. *Burton Island* to traverse the ice pack, then transferred to the U. S. S. *Mount Olympus* to travel to Wellington, New Zealand. Air travel from New Zealand to United States by way of Australia was directed by the War Department.

Several days were spent in Wellington and Auckland conferring with government officials and scientists. The trip from Auckland to Sydney, Australia, was via BOAC flying boats. Approximately 2 weeks were spent in Sydney, Adelaide, and Melbourne conferring with the Australian scientists, engineers, and government officials. Flight from Sydney to Washington, D. C., was by ANA DC-4 to Fiji, Canton Island, and Hawaii; then by ATC C-54 to San Francisco and Washington, D. C.

establish semi-permanent bases within the South Magnetic Polar area for atmospheric electricity, weather, and magnetic studies. South Africa also was planning Antarctic scientific studies. A joint British, Norwegian, Swedish expedition was being planned, as well as Argentinian and Chilean efforts toward expeditions and encampments in the Antarctic. The systematic planning of the scientific studies of importance to be gained in the Antarctic, and the fitting of various nations' scientific efforts into this plan, could result in an integrated series of stations that could cooperate with the already established studies of modern science to determine the basic phenomena and the anomalies occurring within these phenomena. In contrast to this, the establishment of a single station does not necessarily separate the basic phenomena from the anomalies.

It was early recognized that one of the chief obstacles that must be overcome was the situation surrounding the claiming of territory with the resultant chaos that is sure to result if no definite understandings or agreements are made before joint endeavors are

undertaken. It was repeatedly suggested that the United Nations Organization might be the ultimate answer to this problem; that any natural resources could be administered by the U. N., that the preservation and utilization of fish, animals, and natural life, be controlled by that organization. A second, though less desirable alternative was suggested—that the nations entering into joint scientific endeavors should not use any of the aspects of those endeavors as claims in the future against the other members participating in those same endeavors, and that all results obtained by any member would be freely disseminated among all participating members.

The military implications of Antarctic research were recognized, but are not to be discussed in this paper because of the obvious classification. Many of the aspects of military importance and planning were presented after return of the authors to the War Department through WDGS, R&DD, Office of the Secretary of War, the JRDB, Deputy Chief of Air Staff, R&D, and to the Commanding General, Strategic Air Command.

SECTION II. The International Scientific Plan

A joint International Scientific Plan for the exploration of the scientific aspects of the Antarctic has been proposed.⁴ Under this plan, those nations able and interested in taking an active part in the program would submit their abilities and their desires to the central planning agency which would then outline a general program. Each participating nation would then join in a conference of the delegates to determine the best ap-

proach and to outline a detailed plan which would place the responsibility of accomplishment of the individual phases upon those agencies best able to accomplish it. It is suggested that a series of stations be established, one or more stations to be manned and managed by each participant with exchange members from other stations, or from scientific establishments, rotated for better analysis and coordination. Transportation of men, equipment, and supplies would best be supplied through a central planning pool to prevent overlap of effort and to assure the fullest possible support of all installations.

⁴ The complete plan with the details, principles, and values to civilian and military agencies has been deleted from this report because of its military classification.

The following are some of the projects anticipated.

1. Radar reconnaissance of the entire Antarctic Continent could give the locations and general features of all land changes that give irregularities or discontinuities in the surface. This would allow a very early geomorphological study of the Antarctic Continent and indicate those areas in which exploration and visual mapping would be most valuable.

2. Airborne magnetometry, in conjunction with the radar survey, would contribute a great deal to geological studies and would further indicate those areas requiring specialized or immediate exploration, photography, and mapping.

3. Systematic aerial reconnaissance and mapping of the areas of immediate interest would supply the required information for the formation of exploratory efforts.

4. Establishment of stations at critical points, such as a South Magnetic Polar station for the basic study of cosmic ray atmospheric electricity and magnetic phenomena; Polar plateau stations to study climatology, glaciology, weather, astronomy, physiology, biology, and medicine; peripheral stations to study biology, glaciology, seismology, mineralogy, physiography, physiology, oceanography, meteorology, climatology, and hydrobiology, in addition to atmosphere, gravi-

tation, magnetism, atmospheric electricity, and medicine. Each of the stations would also be able to act as a base for radiating parties for emergency rescue, or for studies requiring ground contact.

5. Establishment of a program for the coordination of mobile studies to determine if and where any natural resources may be. Some of the new travel equipment that will make these endeavors much superior to previous expeditions are the new type ice breakers, the long range aircraft for aerial supply, the abilities of gliders to land and be snatched from many areas, the utilization of small air towable aircraft for great mobility at long ranges, and some of the newly developed tracked type vehicle equipment.

The current interest of so many nations in the same or similar types of studies stresses the need for international cooperation and joint effort, especially when it is realized that the Antarctic contains six million square miles of continental mysteries, of which essentially only a fringe has even been seen by man in his hundred years of Antarctic exploration.

Ideally, the joint international scientific exploration would be administered by the United Nations Organization, but since that organization is not yet ready to function in this manner, it is proposed that an English speaking condominium be established to organize and administer such a plan.

SECTION III. Joint Aerial Exploratory Program

If neither of the before-mentioned programs materialize, it is proposed that an American airborne program be established to make a few trans-Antarctic flights to explore and demonstrate the following:

1. A trans-Antarctic flight from South America to New Zealand or Australia would

demonstrate the ability of United States aircraft to fly anywhere.

2. Some of the greatest geological mysteries of the world lie hidden in the vastness of interior Antarctic. Good radar, visual, and magnetometric surveys might solve these mysteries.

3. This flight or these flights would demonstrate that a route primarily above land from the Americas to our friends "down under" exists in actuality, and a friendship aspect can be demonstrated.

4. If one of these flights continued on

around the world, completing the first north-south trans-world flight, the strategic abilities of American aircraft and techniques would be demonstrated as superior to any other nation's. This has important implications in prolonging the peace.

SECTION IV. The Antarctic Is Different

It is pointed out that the Antarctic is greatly different from any other section of the earth. This results from the fact that it is a great continent with some very great heights and perhaps includes the largest high level plateau from which the world's coldest weather comes. In the North there

is the Arctic Ocean which stores the summer heat. This summer heat is released in the winter months, thus preventing extremely low temperatures. In the South air temperatures high enough to cause melting are a rarity even on the hottest days of mid-summer.

SECTION V. Conclusion

This chapter does not pretend to give a complete plan of action, nor does it attempt to make complete tabulation of the sciences and their aspects that can best be exploited in the Antarctic. It endeavors to suggest that certain courses are now open to scientific

exploration, and that the results of appropriate exploration are of prime importance. The evaluation of the benefits to be obtained can be complete and authoritative only when made by consultations with the men who are the scientific leaders in their fields.

COMBINED OBSERVERS' LOG

This is the combined log of the Army observers¹ who were assigned to the United States Navy's Task Force 68, Operation Highjump, Naval Antarctic Project. The Army observers sailed from Norfolk, Virginia, on 2 December, 1946 aboard the U. S. S. *Mount Olympus*, Flagship of the Task Force, with Rear Admiral Richard H. Cruzen in command.

The personnel serving as War Department observers on this operation, together with the agencies they represented, were as follows:

Dr. Paul A. Siple, Research and Development Division, War Department General Staff, who also served as assistant and advisor to Admiral Richard E. Byrd, in charge of the Antarctic project on polar, scientific, and technical matters. Doctor Siple joined the *Mount Olympus* in Panama.

Lt. Col. John N. Davis, Infantry, from the Infantry School.

Lt. Col. Willis S. Johns, Air Corps, AAF Communications Services.

Lt. Col. Robert C. Love, Medical Corps, Office of the Air Surgeon, Headquarters Army Air Forces.

Major James H. Holcombe, Corps of Engineers, Office of the Air Engineer, AAF.

Major Dan Crozier, Medical Corps, Brooke Army Medical Center, Fort Sam Houston.

Captain Charles H. Harrison, Air Corps, Army Air Forces, Air Weather Service.

Captain Murray A. Wiener, Air Corps, AAF Rescue Service, Army Air Forces.

Chief Warrant Officer, A. J. Morency, Corps of Amphibious Engineers.

Mr. Amory H. Waite, Signal Corps, Fort Monmouth, N. J.

First Sergeant S. A. London, AAF Rescue Service, Army Air Forces.

Mr. Robert N. Davis, Operation Analyst, Strategic Air Command, Army Air Forces, who served as special radar and scientific advisor to Admiral Byrd.

In addition to the above, four United States Army photographers were on the expedition as active participants under Navy direction. Two of the four photographers were attached to the Central Group. These were T/5 John Shimberg and T/5 J. Waltersdorf. The other two were T/5 E. Zinberg, with the Eastern Group, and T/5 H. C. Foster, with the Western Group.

The U. S. S. *Mount Olympus* arrived at the Panama Canal Zone on 7 December and departed on 10 December. While in the Zone it made rendezvous with ships from the Eastern and Western Groups. Doctor Siple joined the *Mount Olympus* at this point on the 9th. The equator was crossed on 12 December. On 13 December, while at sea, the Army Group had its first official meeting to discuss plans for War Department obser-

¹ On the return voyage the Army Observers brought together their individual logs and each contributed to the master entries. The first portion was summarized by Dr. Siple; however, after reaching the ice the contributions are preceded by the name of the individual from whose log the notes were taken. This combined log as well as the Appendix III *Quartermaster Questionnaire For Navy Task Force 68* were recorded by voice during conference onto a magnetic wire recorder loaned by the General Electric Company for the purpose. Col. Davis and Capt. Harrison were aboard the *Tancey* and therefore contributed to the log only by final checking. The first draft was transcribed in Sydney Australia through the courtesy of Mr. Hooke in order to expedite editing of the material during the return journey.

vations. During the crossing of the Pacific Ocean, daily lectures were held in the wardroom for all Task Force officers and observers on various plans and objectives of the expedition and conditions to be encountered. These were attended by all of the Army personnel. Several meetings a week were held by the Army observers to plan their program for observations. This was summarized before reaching the ice pack so that each participant would have a complete picture of the observation plan.

On 21 December the U. S. S. *Mount Olympus* refueled at sea from the U. S. S. *Canisteo* which was accompanying the *Mount Olympus* enroute to the Antarctic. Also accompanying the U. S. S. *Mount Olympus* was the submarine U. S. S. *Sennett*. On 30 December the U. S. S. *Mount Olympus* reached Scott Island. On the same date word was received of the loss of a PBM from the U. S. S. *Pine Island* of the Eastern Group. At Scott Island a rendezvous was made with the U. S. S. *Merrick* and U. S. S. *Yancey*.

The ice pack was entered at 1400 on 31 December near latitude 68°30' south and on the 180th meridian. Before entering the ice pack a reconnaissance of ice conditions was made by the ice breaker U. S. C. G. *Northwind* and a helicopter flying from that ship. Admiral Cruzen transferred to the *Northwind*, which preceded the group into the ice pack. Army photographers Waltersdorf and Shimberg were transferred to the *Northwind* to photograph the pack ice while going through it. By early morning on 1 January, it was apparent that the ice pack was much heavier than had been anticipated. The cargo ships *Yancey* and *Merrick* and the *Mount Olympus* had all begun to suffer minor damages. The *Mount Olympus* had 11 frames on her starboard bow crushed and was leaking through minor holes. At this point we reached what was later called Frustration Lagoon and remained in that vicinity for

several days because of a propeller that was badly bent, necessitating a reduction in speed.

On 2 January an attempt was made to move out between several large icebergs and large pieces of bay ice. The large ships got through fairly well, but the submarine *Sennett* became jammed. On 3 January the *Northwind* had to go back and rescue the *Sennett* and take it back to Scott Island.

On 4 January the positions of the *Yancey*, *Merrick* and *Mount Olympus* became dangerous due to bad visibility and uncontrollable drift of the ships in the pack toward large icebergs. The *Northwind* was called back to remove these ships to a safe distance from the icebergs. On 4 January, while the *Northwind* was still too far away from the three ships in danger, the skippers began to plan relief methods of their own. There was a quantity of explosives on the *Merrick* and *Yancey* and an effort was made to see whether or not these explosives could be transferred to the *Mount Olympus*. Capt. Boyd, U. S. M. C., Mr. Perkins, and Dr. Siple skied out halfway between the ships over the sea ice to prove that this could be done. However, the *Northwind* returned before danger became imminent.

Mr. Waite:

On 5 January the *Northwind* returned to take the *Sennet* to Scott Island. At 0200 on 6 January the *Northwind* returned to the three ships and started on southward through heavy pack to a wide open lead 10 miles long. We got to 70°36' south, but were forced to stop by heavy ice on the south side of a lagoon. We then returned to 70°32' south, where we remained the rest of the 6th.

Maj. Crozier:

A J2F Grumman Duck from the *Northwind* took off on an ice reconnaissance flight to the south.

T/5 Shimberg:

During this 24-hour period Admiral Cruzen

made six helicopter scouting flights over the pack ice. On the 8th we had drifted back in the lagoon to a position of 70°16' south, 178°18' west. Dr. H. H. Richardson, Jack Perkins, and Dr. Siple skied out onto the bay ice where they killed a crab-eater seal for a biological specimen and dog food. Choice cuts were served as a novelty at the mess. Also captured was an oddly marked immature Adelie penguin. Dr. H. H. Howe accompanied this party to make dip circle measurements of the magnetic field on the ice pack away from the disturbing anomalies of the ships. Geologists and others also made short excursions out onto the pack ice.

Capt. Wiener:

On 8 January the J2F Grumman from the *Northwind* made a 150-mile flight south, reporting a solid ice pack for approximately 40 miles, then loose pack ice. No open water was sighted. To date, the *Mount Olympus* has had 17 frames bent in and is taking in quite a bit of water.

Dr. Siple:

On 9 January the *Northwind* made an effort to scout the pack ice for possible leads to take the ships on farther to the south. The ships stayed in the same vicinity all day drifting nearly 6 miles northward. On this date the U. S. S. *Philippine Sea*, the aircraft carrier bringing the R4D planes to the Antarctic, left Panama.

Maj. Crozier:

On 10 January we got under way at 0900 and steamed south to southwest for almost 2 hours until we came to another large lake. The PBMs from the Western Group flew over but because of poor visibility were able to give us practically no pack ice information. We remained at this lake until visibility improved and ice conditions changed.

Dr. Siple:

Because of the heavy pack ice conditions, which were more severe than had ever been noted in this vicinity before at this time of

the year, the PBMs of the Western Group were called to the Ross Sea area for reconnaissance, from which area they explored along the Antarctic Coast south of Australia. They arrived in the 10th and made their first flight, but poor visibility prevented their observing anything worth while to make navigation easier for the ships.

Capt. Wiener:

On 10 January we were about 600 miles from the Bay of Whales. We sailed approximately 30 miles, mostly in circles, making good about 6 miles to the southwest.

Capt. Wiener:

On 11 January we received good news—the missing aircraft was found. The PBM was located about 7 o'clock this morning at latitude 71°03' south, longitude 98°47' west, approximately 10 miles from open water. The plane was reported crashed and burned with six of nine personnel aboard the crashed aircraft still alive. The rescue PBM from the *Pine Island* landed in water near the edge of ice. Five survivors walked to open water, pulling, on a small sled the sixth survivor, whose legs had been burned and frozen. Later his legs had to be amputated.

Mr. Waite:

At 1100 on the 11 January additional word was received that Lt. James Ball from the *Pine Island* in another Martin Mariner PBM aircraft had also sighted the lost PBM about 8 miles in from the edge of the ice, and 35 miles north of Cape Dart on the tip of Thurston Peninsula. Details gathered of the crash disclosed that the PBM had entered clouds, reducing visibility to zero. The land, being only roughly charted, was farther north than was indicated on the crew's map. Without warning their wing tip had grazed a snow-covered slope and the careening plane apparently exploded in midair under full power only a few feet off the surface. Most of the surviving members of the crew were thrown clear of the flame-engulfed

plane about 20 miles from where it had sent its last position report on 30 December.

T/5 Shimberg:

We began our journey southward on the 11th, at 0600. The U. S. S. *Mount Olympus* was stuck 12 times in the first 24 hours. By 1800 that afternoon we had traveled 20 miles.

Mr. Waite:

About 1200 on the 11th two Martin Mariners took off from the mother ship *Currituck* about 50 miles north of our position to assist us. They were guided to us by our radio instructions and by radar observations and flew over us at 3:20 p. m. local standard time. The planes were identified as B1 and B3. One of them flew on each side of the course we were following for about 10 miles east and west and explored the ice ahead. They found loose pack ice at 71°45' south, 60 miles away, and apparently open water 150 miles south of that.

T/5 Shimberg:

By 1200 on 12 January we have traveled 80 miles in 24 hours at the rate of 6½ knots; latitude is 71°46' south.

Capt. Wiener:

On 13 January we sailed south all day at approximately 6 to 8 knots, through very loose pack ice, mostly open water.

T/5 Shimberg:

We are now about 250 miles from the Bay of Whales.

Maj. Crozier:

It seems that the pack extends farther north this year than ever before recorded. The previous record was 74°50' south.

Mr. Waite:

We bucked through ice during the 13th and 14th until 10 p. m.—we had 24-hour daylight, of course—when the radar screen showed the ice barrier ahead of us at last.

Capt. Wiener:

On the 14th we were sailing south of the ice pack in fairly open water, proceeding through only one small stretch of old bay ice. It was reported that we officially

broke out of the ice pack at 1300 hours today at latitude 76°53' south, longitude 179° west.

T/5 Shimberg:

The Flag (Adm. Cruzen) was transferred today back to the *Mount Olympus* at 1330. Huge icebergs 100 feet high were sighted.

Mr. Waite:

Just prior to midnight on the 14th, the outline of the northwestern promontory of the Discovery Bay Peninsula was sighted on the southern horizon.

Dr. Siple:

The tip of Discovery Inlet could be seen about 15 miles from the ship. It was first picked up by radar and believed to be an iceberg. Considerable discussion transpired on this point, until proof could be made that it was the tip of Discovery Inlet. However, to many accustomed to observing the sky, the outline of Discovery Inlet was unmistakable as were the shadows of the water on the clouds (water sky). This was also shown in photographs which were taken at this time.

Observation of the peninsula was confusing to most people, for even the radar did not pick up the far southern edge of the barrier itself until we had steamed some 10 or 15 miles farther south. We went around the tip of the Peninsula until we could see into the inlet and discovered that it was filled with bay ice and was casting white shadows onto the barrier walls. This affected the light in the vicinity and made it very difficult to see forms.

Mr. Waite:

Early on the morning of the 15th we sailed toward the mouth of Discovery Inlet on a course of 140° until we could see the barrier stretching westward toward South Victoria Land. Then we turned back eastward around the tip of the peninsula and headed toward the Bay of Whales. Forty-eight miles to the east we passed Lindberg Inlet, taking photographs all the way. The Inlet was full of bay ice. We then proceeded to

the Bay of Whales, 85 miles east of Discovery Inlet. When we arrived at the Bay of Whales the larger ships stood by outside while the *Northwind* proceeded into the Bay. Official arrival time was 0835 on the 15th. When the *Northwind* had proceeded into the Bay and broken ice for approximately 1 mile to the southwest, Dr. Siple, Commander McCoy, and Commander Campbell, Base Commander, skied up onto the shelf ice and sighted the west base (Little America III), built by the 1939-41 expedition, and then returned to the ship. Their mission was to locate a place suitable for unloading and to pick a site for the base camp and landing field. However, due to overcast conditions, visibility was so poor they desired to repeat the reconnaissance before definitely picking the sites. Despite the overcast conditions all three had sunburned faces when they returned.

Dr. Siple:

The Capes of the Bay of Whales were nearly closed—only some 600 or 700 feet wide. The bay ice covered the entire area of the inner lagoon portion of the Bay and the *Northwind* had to break out the ice from the very entrance at the capes. This bay ice was only 4 or 5 feet thick at the start, but as we advanced inward, the ice became thicker and apparently much older. Before the final work of breaking up the bay ice, the *Northwind* was attacking ice from 12 to 20 feet thick. This is remarkable in view of the fact that this was a much different form of ice breaking than out in the pack where the ice moves away from the side of the ship. The *Northwind* actually would rise up on top of the ice and break it down. The cakes would stand up on edge. The bay soon filled up with ice, but with the aid of a gentle southwest wind most of the ice was carried out. When the wind shifted, the ice jammed up in the bay so that it made it difficult to bring the bigger ships in until there was

another favorable change in wind direction.

The *Northwind* continued breaking up the bay ice in the Bay of Whales all during the day and night of the 15th and 16th.

On the 16th a second party was sent ashore as on the first day visibility had been so poor that the character of the proposed airstrip was indistinct in the white light.

On this day the shore parties traveled to West Base and actually entered the buildings and found everything in good condition, although they were snowed over up to the height of the ventilators and smokestacks.

On 17 January the *Northwind* continued to break ice. Due to a shift of wind the ice stayed in the Bay and made it difficult to bring in the other ships.

At 2300 on the 17th, the *Yancey* sailed into the Bay of Whales, and after considerable difficulty was brought up alongside the solid bay ice where the *Northwind* had laid deadmen (i. e., anchor in the snow) for her.

At about 4 a. m. the ship was securely anchored and the first shore parties started off to reconnoiter passages for vehicles through the pressure ice, across cracks, and for a suitable slope up the barrier onto the shelf ice. A second party under Commander Reinhart went up on top of the shelf ice to lay out the airstrip in a southeasterly direction. Captain Boyd and Dr. Siple reconnoitered the full length of the first pressure ridge and found the best location for a possible crossing.

Immediately after the first vehicles were unloaded, the first bulldozer came over and leveled off the area through the pressure ice to permit crossings at this point. The second crack of a shear type, which had been noted to be moving very rapidly, had to be bridged in order to get the vehicles across it.

T/5 Waltersdorf:

The bridge over the first part of the pressure ice ridge was completed at approximately 1300 in the afternoon of the 18th. At that time the first of the vehicles started to cross the first ridge.

Dr. Siple:

Unloading from the *Yancey* proceeded at full pace. The first vehicles put over the side were mainly 6-wheel trucks and jeeps which could not operate on the snow surface and later had to be dragged away by tractors to clear the side of the ship. The Weasels and tractors worked successfully over the ice but were not able to take the initial loads past the shear crack until it was bridged.

T/5 Waltersdorf:

Before most of the tractors were able to cross the first bridge, Captain Boyd supervised the installation of extensions to the tractor tracks.

Lt. Col. Johns:

It was evident at this time that certain curtailments of the operation would be necessary due to the condition of the icepack and the necessity of removing the thin hulled ships before it got too heavy. The date of retreat was set for approximately 5 February.

Dr. Siple:

On 18 January Dr. Siple had an opportunity to take a helicopter flight over the Bay of Whales area to reconnoiter the ice conditions. It was apparent that the West Cape had actually closed against the east wall of the Bay and had broken a large portion off West Cape and gouged out a portion of the eastern wall of the barrier. Tremendous pressure closed the central portion of the Bay and many new rifts were visible. The flight went far enough southward so that the site of old Little America I and II was visible. The radio towers were still sticking some 15 to 18 feet out of the snow, leaning over perceptibly, and the wind generator on one of the towers could be seen still turning over.

Unloading continued as rapidly as possible on the 18th and 19th. However, supplies began to pile up alongside the ship, as the

vehicles which were available to handle the supplies from the side of the ship were limited. This was due primarily to difficult snow conditions in the vicinity of the first pressure ridge and the considerable new bridging that had to be made. The second crack created quite a problem which was not solved until an adequate bridge was put across.

The first tractors that tried to go up the barrier slope were unable to make it except for the D-6 tractors which had wooden extensions on them. The bulldozers, and other vehicles without wooden extensions, could not crawl up the side of the barrier. Also, at this time it was impossible to bring any sleds up the barrier, even with the D-6 tractors with wooden extensions, with the exception of the 1-ton Army sleds. The Go-devil sleds could not be hauled on the surface at this time because the snow was quite soft and sticky. Although there was a glazed top on the surface, which made skiing very easy for the men, the sleds dug through this level and heavy loads could not be handled on this soft surface.

The temperature at this time was about 27° F. During the first stages of the unloading, the only Army observers present were T/5 Waltersdorf and T/5 Shimberg, the photographers who stayed with the *Northwind*, and Dr. Siple who was billeted aboard the *Yancey* during this period. The *Mount Olympus* and *Merrick* were still at sea outside the Bay of Whales.

Maj. Holcombe:

The 19th Major Holcombe also came into the Bay and was billeted aboard the *Yancey* and the actual erection of the tent camp started on the night of the 19th.

Mr. Waite:

On the 19th a group of observers from the *Mount Olympus* made a trip to Little America III with Captain Quackenbush and Captain Kosko for the official opening of the old base. Those present were Dr. Howard, Mr. James

Balsley, Dr. Siple, Captain Boyd of the Marine Corps, Captain Murray Wiener of the Air Corps, Lieut. Richardson, Lt. Commander McCoy, Lt. Commander Dustin, Mr. Jack Perkins, and Mr. Waite. This was called the official opening in view of the fact that photographers were not present on the 16th. Pictures were taken of the old buildings visited, tunnels were opened up, and so forth. By this time the bay had been broken out to a depth of 2 miles by the *Northwind*.

We traveled approximately 3 miles from the ship to the camp. On the trip to West Base Capt. Wiener, Mr. Waite, and Mr. Perkins skied behind the Weasel at a rather rapid rate of speed. During this period Jack Perkins fell and, although it was not known until later, broke his ankle. The snow was found to be between 15 and 20 feet deep over the buildings at Little America: the temperature was -1° F. inside the building.

Capt. Wiener:

Word was received from the U. S. S. *Pine Island*, of the Eastern Group, that they had lost their helicopter. Apparently the rotor blades iced up and the plane came down in the water alongside the ship. There were no casualties.

T/5 Waltersdorf:

At midnight on the night of the 19th, the sun became obscured and the building of the tent camp was somewhat hindered by a strong wind and drifting snow.

Maj. Crozier:

The mail closed at midnight on the night of 19 January.

Capt. Wiener:

Early on the morning of 20 January, the U. S. S. *Merrick* entered the Bay of Whales and tied up to the bay ice between the *Yancey* and the west side of the Bay.

Dr. Siple:

Both of the ships had their noses pointed toward the west side of the Bay and were

consequently in a difficult position when ice later crowded into that corner of the Bay. About 1630 the *Northwind* sailed north to a rendezvous with the *Philippine Sea*, which is taking the outgoing mail with her.

Maj. Crozier:

A seaman named Wordell, 17 years old, was accidentally killed on a "sheepsfoot" roller during unloading operations.

Lt. Col. Love:

This accident was of the type that might have happened on any construction job in temperate zones.

T/5 Waltersdorf:

On the evening of the 20th about 18 of the pyramidal tents were up. An ice box (built of snow blocks) 30 by 15 by 7 feet was under construction at the base camp.

Mr. Waite:

On this date a world-wide radio black-out, caused by natural phenomena, cut off communications with the United States for a period of 24 hours.

Capt. Wiener:

On 21 January Dr. Howe and Lt. Richard Byrd, Jr., located the old absolute magnetic house at west base, covered over with 7 feet of snow. They decided it would not be advisable to utilize this building for the purposes of making magnetic observations.

Lt. Col. Love:

Today it was announced that, beginning tomorrow, regular shuttle boats will operate, and all who desire can go ashore. Departure will be at 8 a. m. and return will be at 4:30 p. m.

Capt. Wiener:

Captain Murray Wiener was ordered ashore today to work with Commander Reinhart and the Seabee personnel setting up the base camp.

Sgt. London:

Approximately 0930 hours on this date, Sergeant London moved ashore with the sled dogs and all sled equipment. Several

hours were spent in harnessing the dogs to the sleds and moving to the top of the barrier ice. Twenty-seven adult sled dogs were moved to the base camp. The area picked to tether the dogs was about one-fourth mile west of the base camp. We had four small puppies along with this group, approximately four cargo sleds, and one man-hauling sled.

Mr. Waite:

Dr. Siple, Dr. Howard, and Mr. Waite, on skis, accompanied by Lt. Ellis and Correspondent Sparks, on foot, proceeded to the 1929 Byrd Expedition marker on top of Haycock Point, on the south cape of Floyd Bennet Inlet. From there they continued approximately 2 miles farther to the mouth of Seal Canyon where 200 seals were examined for brand marks made by the biologist of the 1934 Byrd Expedition.

Dr. Siple:

Near this point there was a large rift in the west side of the barrier wall of the Bay of Whales. It was named Seal Canyon because of the great concentration of seals in this area. From the air it had been observed that nearly 50 percent of all the seals in the Bay were concentrated in that region in a position that might be very difficult for them to get out of. This rift had sheer walls starting at 25 to 50 feet high, running to over 100 feet high, running back into the shelf ice about three-fourths of a mile.

Capt. Wiener:

The second accident in the unloading operations occurred today, resulting in a finger amputation of a sailor from the U. S. S. *Merrick*.

Sgt. London:

The killing of Weddell seals for dog food began on the 21st. Each day, for 1 week thereafter, a seal was killed; later we began feeding one seal every third day.

T/5 Waltersdorf:

At 1432 on 21 January the *Mount Olympus* threw ashore its first mooring lines to the Bay ice. Unloading of the JA-1 Norseman airplane, coal, and supplies began immediately.

Lt. Col. Johns:

On this date a sea leopard was seen and killed by Captain Kosco. It is very unusual to discover a sea leopard in this area, as it is far from its natural habitat, which is normally out in the ice pack.

Dr. Siple:

Animal life in the Bay of Whales was quite conspicuous by its absence. Very few whales were seen in the Bay. Only one or two were reported during the entire time we were in that vicinity. Skua gulls were present at all times. The Snowy Petrel and Antarctic Petrel were extremely scarce in the Bay of Whales in comparison to their almost constant presence in former years. Wilson Petrels and Southern Fulmars were absent entirely. Penguins were also very scarce. Five Emperors were found molting in the Bay upon arrival, and these were about the only Emperors that were seen during the entire stay. A few Adelie penguins were found but they also were very scarce. Apparently the narrowness of the entrance to the Bay made it much less attractive to animal life, but the Weddell seals were there in full concentration because that is their permanent home. Crab-eater seals usually found at the mouth of the Bay were also almost entirely absent.

Lt. Col. Love:

A few of the Army observers who had not previously been ashore on special missions were given permission to go ashore in the shuttle boat on this date, 22 January. The day was spent ashore in looking over the base camp and becoming oriented. They returned to the *Mount Olympus*, which in the meantime had entered the Bay and was tied

up to the ice by the end of the day. The observers found that the plans had been changed and starting with the next day the Army observers were authorized to move ashore and quarter at the base camp.

Maj. Holcombe:

On the 22d, the last of the tents for the 200-man tent camp was erected. Later on a few more odd tents were erected around base operations.

T/5 Shimborg:

The Norseman (JA) took off on its initial flight, equipped with skis. Lt. Comdr. McCoy was pilot, Comdr. Campbell, C. O. Base Camp, was co-pilot.

Capt. Wiener:

The first of the emergency equipment for the emergency camp was moved to the West Base (Little America III). Also on this date the flag route was laid between the base camp and the West Base (site of the emergency camp). Prior to moving the first load of emergency equipment to the West Base, Dr. Siple, Capt. Boyd of the Marine Corps, and Capt. Wiener went out to establish the most suitable site for the twin Quonset huts which were to house a portion of the emergency camp.

Maj. Holcombe:

On the 23d the erection of the Quonset hut at base operations was started. Most of the supplies which were unloaded this day went to the "airdale" cache at base operations and to the Seabee cache in the main camp. By this time the "Go-devil" sleds were hauling all supplies, being pulled from the ship's side to the bottom of the barrier by D-6 tractors without track extensions. They were then winched to the top of the barrier and from there were pulled by D-6 tractors with track extensions to the proper cache.

Capt. Wiener:

Information has been received that a second helicopter has been lost, this accident

taking place alongside the *Philippine Sea* (aircraft carrier), yesterday.

Mr. Davis:

The Sikorsky R5 (Navy designated HL3F) helicopter that went into the water from the *Philippine Sea* made a normal take-off after proper warm up with full engine power and complete control. The helicopter hovered above the foredeck of the *Philippine Sea* for several minutes checking stability and control. Slowly it turned toward the "island" (aircraft carrier's superstructure) and then started a run across the deck toward No. 2 elevator. The helicopter was under good control at that time and flying on the air layer trapped between the rotors and the deck. Upon approaching the side of the carrier it ran into a down draft that was coming from the starboard side of the deck, sweeping across the deck and going down the port side. With this down draft and loss of lift, due to the loss of the ground or deck layer of air, the helicopter dropped rapidly until its wheels were submerged in the water. The helicopter rose a few feet above the water. This time the pilot decided that it was appropriate to ditch the helicopter, which he did by breaking the blades through tipping. The three men escaped very rapidly with no resultant casualties. The men were in the water for about 17 minutes, one of them becoming very badly chilled and requiring medical aid to revive him after he was received aboard the *Philippine Sea*. The accident happened while the *Philippine Sea* was under normal cruising conditions.

Mr. Waite:

The *Northwind* en route to rendezvous with the *Philippine Sea*, reported that 350 miles of open water lay between the Bay of Whales and the southern edge of the ice pack.

T/5 Waltersdorf:

On the second flight of the Norseman by Lt. Comdr. McCoy, an iceberg was seen

floating toward the mouth of the Bay of Whales.

Mr. Waite:

As this berg proceeded toward the mouth of the Bay of Whales, it was decided that it would be necessary to remove the three ships, since there might be possible danger. The *Mount Olympus* immediately sounded a warning whistle and let go its mooring lines, leaving the edge of the Bay ice at approximately 11:45 p. m. on the 23rd, followed shortly afterward by the *Yancey*. The *Merrick* was the last ship to break its moorings at 0330 hours.

Lt. Col. Johns:

The iceberg eventually drifted into the spot previously occupied by the *Merrick*, which showed that the evacuation of the ships was wise.

Dr. Siple:

This iceberg was of particular interest in view of the fact that it was a section of shelf ice foot, because of its shape of one high side and one low side. The berg appeared ominous and much larger than it really was because it advanced into the Bay with its high side toward the ships, and appeared to occupy nearly half the width of the opening. It was also peculiar in the sense that it had a different color than any of the typical Ross Shelf icebergs. It was much more of a blue-green color and appeared to be composed of extremely dense ice, although no samples could be taken.

Maj. Crozier:

The first meal at the base camp mess hall was served on the evening of 23 January. This involved the beginning of ice melting operations which were carried on in an improvised shelter adjoining the mess hall. On this date the Army observation group were located as follows: Lt. Col. Love, Mr. Waite, Maj. Crozier, T/5 Shimberg, T/5 Waltersdorf, Capt. Harrison, and Sgt. London were located on the ice. Dr. Siple, Major Hol-

combe, and Capt. Wiener were on the *Yancey*. Lt. Col. Davis was on the *Merrick* and Lt. Col. Johns on the *Mount Olympus*. Mr. Davis was on the *Philippine Sea* and C. W. O. Morency on the *Cacapon*, which was headed for rendezvous with the *Philippine Sea*. When the *Mount Olympus*, *Yancey*, and *Merrick* left the ice late on the evening of 23 January and early on the morning of the 24th, due to ice conditions, Capt. Wiener and Major Holcombe were caught on the ice along with a large number of other people, but everyone was taken care of without difficulty.

Mr. Waite:

As the order was given for the *Mount Olympus* to leave the Bay ice, all lines but one were cast free. Finally she pushed against the bow line to swing her stern out away from the ice and when her stern was swung far enough to give her a chance to move backward, her bow line was let go. She then backed out until she was in the clear water of the Bay and then swung her bow around and stood by pointing northward. A few minutes later the second ship, *Yancey*, cast loose all of its lines but one and attempted the same maneuver, but found herself unable to move because of the pieces of Bay ice that were floating around her. Eventually she attempted to get a line around over the Bay ice to join to another line that was brought ashore from the *Mount Olympus* with the idea in mind of being towed to sea that way. But that line eventually parted and was hauled back to both ships in two separate pieces. Eventually, the LCM heavy duty landing craft maneuvered into position through the Bay ice and by first pushing aside the ice and then pushing the stern of the ship away from the Bay ice managed to maneuver her into a position from which she could back freely into open water. The *Merrick* was freed in a similar manner.

Capt. Wiener:

On 24 January there was a south wind blowing all day long which eventually cleared the Bay of all the loose ice. This afternoon the *Mount Olympus*, *Yancey*, and *Merrick* returned to their berths alongside the ice in the Bay of Whales.

Mr. Waite:

On 24 January the temperature was +18° F. The wind was 10 miles an hour from the south. It was warm all day.

Maj. Holcombe:

On the night shift of the 24th the Seabees started laying pierced steel planks on a test strip 150 feet wide and by morning they had laid 75 linear feet on undisturbed snow.

Mr. Waite:

That night at about 10 p. m. Dr. Siple, Lt. Roscoe, Correspondent Sullivan, and Mr. Waite checked a base line from West Base (Little America III) toward Little America II, traveling approximately 1¼ miles due south, putting down flags every 200 yards; whereupon a 1-mile long line of closely spaced flag was laid due westward to the pressure ice in the bay in an attempt to find an old bamboo marker left by the 1939-41 Expedition. When that proved impossible the group returned to the 1¼-mile point south of West Base and proceeded on a southwest course in an attempt to find markers near the old camp of Little America II. They eventually found the marker at a high point on the shelf surface half a mile north of the depression in which Little America I and II were located.

Dr. Siple:

This was a high point of the entire barrier area, and from this point West Base camp, the tent camp, and the ships in the bay could also be seen. We went down to the old Little America site and visited the remnants which protruded from the snow, but did not make an attempt to dig into an entrance. In addition to the rotating wind generator,

two other observations were of particular interest. Several Skua Gulls were sitting patiently on a little knoll like sentinels awaiting our arrival. The other was the fact that we arrived on the very last day before the final disappearance of the last visible indications on the surface of the Science Building of Little America II. The rim of the smokestack was exactly flush with the snow surface with a 3-inch depression like a golf cup down into the snow-filled stack. (The next blizzard covered this completely.) During this trip on the night of the 24th the temperature reached a new low of +10° F. A strong breeze from the southeast made conditions extremely uncomfortable. The breeze was strong enough to drift snow lightly over the surface but did not restrict visibility.

Maj. Holcombe:

On the 25th, 75 more linear feet of the 150-foot test strip was laid. This time the pierced steel plank was laid on burlap which had been laid directly on undisturbed snow.

Mr. Davis:

Late on the afternoon of the 25th the loading of the *Northwind* by the *Philippine Sea* was going ahead fairly well under rough weather conditions and bad roll. Later that night the destroyer *Bronson* came alongside to discharge mail and a patient.

(Throughout the preparation of this log, C. W. O. Morency, who had kept a good log of his adventures on the *Cacapon*, was eagerly awaiting the time when his log could be integrated with that of the chronological story of the main group of Army observers. He started to relate the following story slightly ahead of schedule. It was so colorfully told that it was recorded unbeknown to him.)

C. W. O. Morency:

This area looks like the Tropics. We got into the Captain's gig and went over to the "Airdale". I talked to the Admiral (Byrd)

for a few minutes and then went back down again. Our gig failed. The *Northwind* sent over their gig and we went back on our ship again. While we were fueling the *Sennett*, the *Northwind* was taking 80 tons of equipment from the *Philippine Sea*.

The morning of the 26th at 0200—beautiful scene—no ice around at all. [“Was that the day you transferred?” asked Dr. Siple.] No, that was not the day I transferred. I transferred the next day. The Captain wanted a bridge player and he didn’t want to let me go that day. About 1600 in the afternoon the wind started to come up and there was a 30-knot wind, and the old *Northwind* was doing hand springs. It hit the *Cacapon* three or four times and the Captain told the Captain of the *Northwind* that if he did not keep a straight course that he would refuse to refuel her, which he did. They refueled the next day and that was when I went over in a bucket. It was rough, I tell you. They said if I did not keep still they would duck me in that water a couple of times. I finally got on the *Northwind* and by the time I got to the *Northwind* they were transferring mail from the *Philippine Sea* to the *Cacapon*. Incidentally, my mail went to the States and I came over here. [“Was there a fog?” asked Mr. Waite.] No, there was no fog. The *Northwind* went out as soon as they got hold of those two planes they ducked in the water, and scouted the ice pack and then they came back again out of the ice pack.

Mr. Davis (Mr. Davis continues the description of activity aboard the *Philippine Sea*.):

On the morning of the 24th the R4D’s were ready to go but the weather and the position of the *Philippine Sea* were such that the planes could not be launched. Early the morning of the 26th, survivors from the PBM came aboard from the *Bronson*. The weather that day was so

rough that no more transfers could be made from the *Philippine Sea* to the *Northwind*. On the following day, which was the 27th, the two OY’s were transferred. These OY’s had been stripped of their wings and empennage, which were crated, and the fuselages were left as they were. During the transfer of the OY’s one of them was first slightly dunked and then very badly immersed when the *Northwind* rolled violently toward the *Philippine Sea*. Some of the movie film was lost during the transfer but very little baggage was lost. Several items of baggage were badly dunked, however. The remainder of the cargo was transferred early on the 27th, the *Philippine Sea* then taking on fuel from the *Cacapon* until late that night. The position of the *Philippine Sea* during this time was maintained mostly by radar around three big characteristic icebergs. There was an absolute calm on the 28th with a heavy fog most of the day. In the evening a strange, weird beauty was lent to the scenery as the bergs turned to a deep blue-green color in the placid brown water.

Lt. Col. Johns:

At this time Chief Warrant Officer Morency is on board the *Northwind* en route to Little America.

T/5 Shimberg:

On 25 January, at Little America, a new crevasse was found on the top of the barrier along the tractor trail where the transfer of a big generator for the G. P. N. (radar), was being accomplished.

T/5 Waltersdorf:

At the rendezvous point the *Sennett* has completed refueling. She will return home by way of Wellington, New Zealand, and Tahiti. Admiral Cruzen has given up hope of taking her into the pack ice again.

Maj. Crozier:

The temperature on 25 January was +13° F. with a 22- to 24-knot wind.

Mr. Waite:

During the afternoon of the 26th Dr. Howard and Mr. Waite went out to the pressure ice looking for ice samples. During this 4 mile trip on skis the temperature was 15° above zero F., and the wind was 15 miles an hour. Very cold.

Maj. Crozier:

Today at 1500 the first formal church service ever held on the Antarctic Continent was conducted at the base camp mess hall by Chaplain Menster.

Dr. Siple:

On the 26th, Dr. Siple moved ashore and during the period of the unloading one of his activities was to measure the ice movement in the Bay of Whales. On the sheer crack where the second bridge was located, there was considerable movement east and west. One side remained still in relation to the east side of the barrier, while the other side of the bay ice moved at a steady pace of approximately 4.4 feet per day. One interesting feature of this crack was that as it sheared, all the loose debris was thrown up onto the surface to form a type of pressure ridge. This is really a false type of pressure ridge because it is not formed by typical pressure that would form anticlines and synclines. The motion is longitudinal slippage along a crack which throws brash ice up onto the surface, forming a ridge over the crack. This ridge can be shoveled clear, exposing the active crack below. There is no form of this ice, as far as is known, thrown down under due to the shearing action.

Capt. Wiener:

At 1800 hours on 26 January supplies started moving out in bulk toward the emergency camp at West Base. Great quantities of Quonset hut materials, food, Diesel oil, and radio parts were moved out between 1800 on 26 January and 0600 on 27 January. It was during this time that a "blizzard" was blowing and it was necessary to form a cara-

van of 4 cats, 2 Weasels, and approximately 15 men who had waited at Little America for 2 hours to let the blizzard blow over a little, until it was possible to pick our way back from Little America to the base camp from flag to flag along the route laid several days previously.

On 27 January at 0700 the *Yancey*, *Merrick*, and *Mount Olympus* went out to sea due to flow ice's moving into the bay and because of the strong wind that was blowing at the time. Practically all activity around the base camp and on the ice was curtailed, due to the fact that most of the working personnel who were standing shifts on the ice had gone out to sea with the three ships.

Maj. Holcombe:

On the 28th the wind was still high and the ships remained outside. At 2145, 33 additional Seabees were taken ashore as a work party. The Quonset hut at the airstrip is now complete.

On 29 January work was started on the double Quonset hut at Little America.

Lt. Col. Love:

By evening of the 29th the weather had become clear and cold, and at this time the decision was made to give the planes on the aircraft carrier their call to fly to the base. Comdr. Campbell sent this message at about 2000 in the evening.

Mr. Davis:

The first R4D take-off ever to be made from a carrier was accomplished by Comdr. Hawks at 2214 on the night of 29 January. The greatest surprise of this take-off was the performance of the aircraft, which came out so exactly to the figures set forth by the Bureau of Aeronautics that no one could believe it at first. The take-off looked very good and led to a great deal of confidence in the next take-off. The second airplane followed the first one almost immediately. The other four aircraft started their take-offs early on the morning of the 30th, No. 6 getting off

of the deck about 0730. All of the take-offs were made with Jato. None of the planes would have needed the Jato. Several of the pilots used the Jato primarily as a safety aid in case of engine failure during the take-off run. Some of the pilots, however, turned their Jato on during standstill. One of the aircraft, having left his brakes in position, caused a great deal of excitement as his Jato burned away and no motion of the airplane resulted. Upon release of the brakes the airplane appeared to jump into the air. There was a relatively good wind especially for the early take-off, the wind running to approximately 30 knots. The relative wind over the deck was approximately 42 to 45 knots for the first take-off. The landings at the base were made with little trouble except for No. 5 airplane, whose pilot allowed his plane to stop before he started his turn back to the base at which time the skis froze to the surface and could not be moved.

No. 6 airplane had navigation difficulty involving some radio failure and turned in the wrong direction upon reaching the barrier. No. 5 airplane stayed in the air approximately 2 hours searching up and down the barrier trying to make radio contact and locate airplane No. 6. Except for that, the mission was an unqualified success.

During the time that No. 6 was trying to maintain radio communication and proclaimed a state of emergency to exist, the "Gibson Girl" was broken out and Lt. Stine operated it while taking pictures of the pack. This emergency procedure allowed the *Northwind* to get into contact with that airplane and help them to orient themselves, flying more directly toward the ice barrier than they otherwise would have done.

No. 5 aircraft landed within half an hour of its fuel exhaustion point. No. 6 aircraft, in the meantime, had located itself, being west of Discovery Inlet, and had turned and

come up the barrier until it reached the Bay of Whales, at which time it landed immediately.

Bob Davis came ashore from the *Philippine Sea* with No. 5 R4D.

Lt. Col. Johns:

On the morning of 30 January, the weather having cleared, the U. S. S. *Merrick* returned and tied up to the ice, followed by the *Mount Olympus*, which was unable to moor to the ice as the break-off of the bay ice had floated away the deadmen that were previously used. These would have to be replaced. As a result, all personnel desiring to go ashore were put over the side and taken ashore in small boats.

Capt. Wiener:

The arrival of the first R4D from the U. S. S. *Philippine Sea* occurred at 0515 hours 30 January, this airplane having on board Adm. Byrd with Comdr. Hawkes as pilot. The temperature at this time, the lowest recorded to date, was -1° F., with a slight breeze.

The actual landing of the first two aircraft was within a very few minutes of their E. T. A. as given on their departure.

Maj. Holcombe:

The planes that came in had a combination ski and wheel landing gear which required 35 to 40 inches of mercury to keep moving. One of the planes stopped and was unable to start moving under its own power.

Mr. Davis:

The R4D's "homed" into the *Mount Olympus* very soon after take-off from the *Philippine Sea*, with the exception of No. 6 aircraft, which had radio trouble.

Lt. Col. Johns:

The second flight of R4D's arrived in Little America at approximately 1220 on 30 January. Approximately 45 minutes later the first airplane of the third flight appeared on the horizon, but due to the trouble encountered by his flying mates in airplane No. 6, he turned and made a reconnaissance

flight of approximately 2 hours to try to help the other airplane in. Therefore, the third flight of R4D's did not land until approximately 1440.

About 2000 on this same date the *Mount Olympus* again pulled out of the Bay of Whales.

Lt. Col. Love:

It was on this day that the bay froze over for the first time, forming a thin sheet of ice that was not hard to penetrate.

T/5 Waltersdorf:

It may be noted here that the weather was closing in as the last plane flight was landing.

Mr. Davis:

The landing of the last two aircraft was materially aided by smoke smudges from barrels of Diesel oil and burlap.

The weather conditions were closing at that time, leading to a bad condition of white-grey sky which gave little or no contrast to the ground. Depth perception was very poor except where man-made objects were on the snow surface. The fact that the smoke from the pots blew directly across the surface gave not only a good indication of wind, but an effect of a horizon outlining the runway, by which a pilot could easily land.

Mr. Waite:

The G. P. N. operators reported that they had picked up the lost plane a distance of approximately 25 miles from Little America.

Dr. Siple:

Operators were also able to follow the plane from the radar equipment on the *Mount Olympus* and aided in the direction of the plane, to get the pilot headed back into the Bay of Whales.

C. W. O. Morency:

On the *Cacapon*, on 2 December, I sailed down toward Little America, but it seemed to me that we had to refuel the *Merrick*, *Yancey*, *Henderson*, *Philippine Sea*, *Northwind*,

and the *Bronson*, also the *Sennett*. Having refueled all these ships here, there, and everywhere, we also held station 400 miles from the *Currituck* and finally I was transferred to the *Northwind* and on my way to Little America.

We went through the pack and it was thick all the way; in fact, it was so thick that an hour after the first two planes flew over us toward Little America, we were jammed into this ice pack to the point where we had to dynamite our way through.

On 31 January at 0800 we came out of the ice pack. At 1300 of the same date we sighted the Ross Ice Barrier.

Dr. Siple:

This brought Chief Warrant Officer Morency to the Bay of Whales, the last of the Army Observation Group to be collected at this point, with the exception of the two Army photographers located with the Eastern and Western Groups.

At the request of Comdr. Reinhart and Comdr. Campbell, Dr. Siple assembled a group of observers to help dig out the entrances of West Base. The group that worked on this project included Lt. Col. Love, Maj. Crozier, Mr. Davis, Lt. Comdr. Dustin, and two photographers. We dug the main entrance out where the hatch had been at West Base. This required digging a hole approximately 8 to 10 feet deep, which was very difficult to locate from the top side. When we went out we were furnished with 40 men, 20 from the *Yancey* and 20 from the *Merrick*, but because of bad weather conditions upon arrival at West Base, the 20 men from the *Yancey* were called back immediately, and before the shovels were in the hands of the men of the *Merrick* they also were called back, leaving only the observation group to dig. While digging the main hole, we started a second entrance, which would be a ramp leading down into the main cache at West Base; however, it soon

appeared to be a herculean task for so small a group to dig this hole, for it had to be dug approximately 100 feet long by 10 feet wide, one end going down 15 feet into the snow. A good start was made, but the weather began to get bad and at the close of the day we reported that a larger working force would be required if that hole was to be finished in time.

At 2000 the wind began to blow much harder from the south and soon reached blizzard velocities.

At 1500 the *Mount Olympus* came into the Bay, but did not tie up to the ice.

A conference was called of the skippers of all the ships, as well as members of the base group, to discuss the plans for the base camp. At this time a list was made up of all the personnel to remain on the ice. The original list included practically none of the Army personnel, with the exception of Mr. Waite, Mr. Davis, Col. Love and Dr. Siple, who were on the original assignment list, to stay with the Ice Party. The general plan was that the *Mount Olympus*, the *Yancey*, and *Merrick* would leave the bay on approximately 6 February, returning through the ice pack in convoy with the *Northwind*. The *Northwind* would then return to the Bay of Whales with the *Burton Island* and pick up the Ice Party. The Ice Party had to be drastically limited because of personnel space on the evacuating ships. It was at this meeting that Lt. Wagner was appointed Base Commander of the 35-man emergency camp and took charge of activities at West Base planning this operation. All during the late evening of the 31st the *Northwind* unloaded her cargo and mail.

Mr. Waite:

About 20 Seabees went to West Base to continue shoveling operations on the new tunnel early the morning of 1 February and were forced to quit operations at noon because of the poor weather conditions. In the

afternoon, however, a group of 12 carpenters did return to West Base to continue their work on the Quonset hut and so forth, and when 6 o'clock came and time for their return to Little America arrived, Weasel drivers were unable to find their way along the southern trail to the camp. After several attempts, a radio call for help was received and two Weasels under Lt. Comdr. Dustin and Mr. Waite proceeded to lay an emergency trail. Observers rode on the outside of the vehicle so that they might see tractor marks in the snow that had been left by previous vehicles, and one flag was put down every few yards so that a very straight and very well marked trail was laid all the way to the camp. The men were picked up cold and hungry, but somewhat comfortable in a pyramidal tent, and brought back to their supper at the tent camp at approximately 2000.

T/5 Shimberg:

That night at suppertime the mail from the *Northwind* came to the tent camp. It tied in very nicely with a blizzard that had started about the same time and gave all the men plenty of time to read their mail.

T/5 Waltersdorf:

It was on the evening of 1 February, during the blizzard, that new evidences of cracks, near the previous crevasse mentioned at the edge of the barrier, were noticed developing. During this night Comdr. Reinhart, while taking a Weasel (M29C) from the ships, onto the bay ice, up to the tent camp, crawled on his stomach every 10 or 15 feet checking the ice surface to make sure that the Weasel was not running any danger of falling into a crevasse.

Maj. Crozier:

The wind velocity at the camp was measured at 40 knots, and at the site of the ships as high as 50 knots.

Maj. Holcombe:

On 2 February, early in the morning, Mr. Sparks, a newspaper correspondent, became

lost while walking from base operations to the mess tent (about one quarter mile). Fortunately, after half an hour or so he bumped into two more men beyond Dog Town who were also lost. The three of them finally found their way to the mess tent.

Mr. Waite:

Just prior to the time that Sparks started from the radio shack to make his way to the mess hall, Chief Saylor and eight radiomen went up for their midnight chow and also became lost. They wandered way around the dog kennels and had gone 100 yards beyond them down toward the pressure ice when they suddenly heard a dog bark or howl, and that gave them their direction and they went back, finding the dogs and eventually making their way back to the mess hall.

Dr. Siple:

This is the first blizzard condition that really affected the expedition, and many men for the first time became serious regarding what a blizzard might mean. Many of the caches began to cover over, and from this time on greater care was exercised in the construction of caches and the marking of supplies. Also, because of the number of men who lost their way, great care was taken in placing flags and trying to prevent interference with trails that were marked. It was interesting to note that the trail between the tent camp and west base, which was originally marked by Capt. Wiener with flags 100 yards apart, was marked after the blizzard at 50-foot intervals with flags of black, orange, and red. It was also interesting to note that this blizzard, bringing the snow in mainly from the southeast and east, produced tremendous drifts, particularly along the "A" row of tents, which were on the windward side. This showed that a snow fence system of some type might help in the construction of a camp, for there was

much less drifting down on the other row of tents and among some of the caches. The wind velocity dropped and visibility became better during the morning. Mr. Davis, aided by Capt. Wiener, was able to put on the wings of his OY plane, and by 1500 the Seabees were back at work again.

Maj. Holcombe:

When the Seabees went back to work on the afternoon of the 2nd, instead of the party's going out and continuing work on the double function hut at Little America, they went down and started repairing the damaged Quonset hut at the airstrip. This damage was caused by snow drifting in around the bulkhead, melting and refreezing between the inner and outer walls.

T/5 Waltersdorf:

It was the afternoon of 2 February that the U. D. T. held its first explosive test in the southern part of the bay ice. The explosive used was C2 demolition blocks.

C. W. O. Morency:

I reported on this date to the *Mount Olympus* from the *Northwind* and went ashore the next day.

T/5 Waltersdorf:

It was on the afternoon of 2 February that a crevasse was located, developing during the previous night at the top edge of the barrier. It was in Y shape and approximately 6 inches in width.

Dr. Siple:

There was considerable question as to whether this crevasse was caused in any part by the demolition activity. The demolition team had placed its charges beyond a pressure ridge between that and the barrier, but it seemed to be quite coincidental that the cracks opened up about the time that the first charges were set off. These cracks opened up very wide all along the edge of the entire ice foot. It may have been due to the continuous piling on of new snow by the blizzard at the foot of the cliff.

T/5 Shimberg:

On the night of the 2nd Waltersdorf and Shimberg were ordered back to the *Mount Olympus*.

Maj. Crozier:

This is 3 February. Maj. Crozier received orders to remain with the ice party for the purpose of accompanying the trail party to King Edward VII Land aboard LVT's.

T/5 Shimberg:

Today (3 February) the men began removing the wheels from the ski-wheel landing gear on the R4D's and adding the extra area plate in place of the wheels.

Dr. Siple:

No. 5 plane was still stuck out on the landing field and could not be moved in with the aid of tractors. This blizzard that we've had made the first remarkable change in the surface of the snow. Prior to this date, the snow had had a glazed surface and there was a great deal of sticky snow. After this date, this type of snow was entirely gone and the blizzard had packed the surface with considerable sastrugi, making the landing field rougher but much harder.

Mr. Waite:

About 9 a. m. on 3 February Admiral Byrd, accompanied by photographers, Dr. Siple, Lt. Comdr. Dustin, correspondents Quigg, Sullivan, Nichols, and Blakely, Mr. Waite, and one or two tractor drivers, proceeded to Little America II to open up the old buildings. The first entrance was made in the tunnel just north of the old science laboratory. The galley, several tunnels, and Admiral Byrd's old home "Dog Heim" were found in fairly good condition. The mess hall roof had caved in and the science building roof had caved in, but food of various types was found intact. Peanut butter, cheese, shredded wheat, grape nuts, ovaltine, malted milk, and apples frozen 12 years were still edible but slightly soft when

thawed. Cigarettes, tobacco, and candy were still intact and enjoyed by all present. Many photographs were taken, as is normal on an expedition of this type, and late in the afternoon the buildings were closed down and the group returned to the tent camp for supper.

Dr. Siple:

Lt. Dick Byrd, Jr., also joined this party. Admiral Byrd was particularly interested in this trip, as he wanted to observe the conditions of the Little America I and II.

T/5 Waltersdorf:

Experiments were held the morning of 3 February with the LVT-3. It entered the Bay of Whales, performing successfully, and then made an attempt to climb up onto the bay ice. However, the edge of the bay ice was too abrupt, not giving enough traction and as a result the LVT had to be pulled out.

Maj. Holcombe:

On 3 February work details from the ships started extending the experimental mat strip.

Mr. Waite:

On 1 February, the first ducking of an LVT took place. One machine was driven into the water and back onto the ice successfully, which resulted in a report to Lt. Shirley that brought about the arrival of photographers for the second more official submersion.

Mr. Davis:

On the morning of the 3rd, the hangar for the OY was commenced. This was felt necessary as the wings had been filled full of snow by the previous blizzard. It also gave a much finer working area than out in the direct blast of the wind.

Sgt. London:

At approximately 1700 on 4 February a parachute jump was made by Sgt. London from an R4D type aircraft. This jump was made from 2,200 feet, wind speed approximately 4 knots. Little can be said about

this jump, it differed very little from jumps made in any other part of the world. The landing surface differed some from landing on an earth surface and certain clothing aspects should be taken into consideration there. The parachute used on this jump was Army standard assembly.

T/5 Shimberg:

On the 4th the U. D. T. finished all the experiments in blasting and exploded linear charges back on the pressure ice. They also made a swim in the bay with special water clothing. They stayed in the water 20 minutes.

Capt. Wiener:

It is interesting to note at this time that all of the U. D. T. boys who made the swim test in the cold water alongside the *Mount Olympus* reported, after coming out of the water, that their hands and feet had been cold for approximately 10 or 12 minutes prior to coming out of the water.

Dr. Siple:

The snow ramp down into west base from the Quonset hut was completed on this date, and food was moved in alongside the old mess hall in the space originally occupied by part of the coal cache. During this period, Lt. Comdr. Dustin, Capt. Boyd, and Dr. Siple rehabilitated the main bunk house of west base. Fires were started in two stoves and the stacks were found to be still clear, although the ventilators were packed with snow. The buildings were cleaned up completely. This state, however, did not last long, for within 24 hours visitors who came into the building continued to pull out all sorts of souvenirs from odd places and the building became ramshackle in a very short time. Also, unofficial opening was made of the "snow cruiser" and it was badly vandalised.

Maj. Holcombe:

On 4 February Capt. Wiener and Major Holcombe were informed that they were

to stay on the ice when the ships pulled out. During these last days quite a bit of equipment was loaded back aboard the ships. Three D-6 tractors with extensions, one with a bulldozer, and two forklifts were left. They also unloaded the remainder of the pierced steel plank that was to be laid on the test strip and finished getting the fuel into the proper caches. All Weasels remained on the ice as well as the two LVT's and four Jeeps. The purpose of leaving the four Jeeps was to make use of their 24-volt generators and 110-volt AC generators which were used to charge batteries.

Mr. Waite:

Using Jeeps for this purpose was a brand new development by the United States Navy and these four were the first ones ever built. The Navy got them for this operation and they worked out very satisfactorily electrically, but as they had to be dragged around by tractor in the deep snow, their over-all value is questionable.

Maj. Crozier:

At this time preparations were going on for the trail party. C. W. O. Morency and Major Crozier were in the process of making trail flags, gathering equipment, medical supplies, and so forth. The remainder of the party was busily engaged in preparing the LVT's and alining the compasses.

Mr. Davis:

All taxi tests by the R4D's were completed on the 3rd. First official flight was made on the 4th at which time Sgt. London jumped. The first take-off was made with approximately 55 inches of manifold pressure with Jato boost. The Jato was used again for protection during the last part of the take-off in case of engine failure. The skis, with the wheels removed, proved to be better for ground operations when the increased area was also removed. The snow piled in front of the little toe of the added area and made taxiing very difficult but with that area re-

moved, taxiing on those skis improved and was deemed satisfactory for further operations.

Dr. Siple:

It was believed that with a light load the planes might be able to take off without the use of Jato. However, it was still felt that with the type of surface condition, roughened by the recent blizzard, that Jato would be necessary with heavy weights of fuel for long exploration flights. On the 4th and 5th practically all the planes available made flights at frequent intervals. Short local flights were made along the bay, including some by the helicopter from the *Northwind* and the *Norseman*.

Sgt. London:

On 5 February Admiral Cruzen decided that it would be a good idea to check some of the Naval personnel out in parachuting for practice in the rescue of downed fliers. Chief Boatswain Johnson was selected and was given instructions by Sgt. London. On the afternoon of 5 February Chief Johnson made his first parachute jump from an altitude of 2,000 feet. He had approximately a 7-mile-per-hour wind speed.

Dr. Siple:

Because of conditions between nations a careful security check was kept on the flying activities, particularly of the Eastern and Western Groups. Up to this date no comment was made to Expedition members, with a few exceptions, in regard to the discoveries made by these flights. The Army group was informed primarily through Dr. Siple as to the geographical accomplishments at this time. However, Admiral Byrd contacted Admiral Nimitz for permission to break security and bring the outside world up to date on the discoveries made at this point. Following is a summary of discoveries announced by the reporters on this date.

T/5 Shimberg:

Accomplishments of the expedition up to date were as follows: Four good sized bays

have been discovered, one by the Eastern Group along Walgreen Coast 180 nautical miles north and south, and 120 nautical miles east and west; 20 small islands discovered, constituting 126,000 square nautical miles of territory unknown until now; 75,000 square miles of ocean flown over and observed; eight new mountain ranges with a height from 1,500 to 15,000 feet; and four mountain groups and three peninsulas discovered, two by the Western Group and one by the Eastern Group.

Mr. Davis:

During the day four of the R4D's took to the air for experimental and test flights. Three of these aircraft were in the air simultaneously for photographic purposes.

Dr. Siple:

On 6 February, for the first time since the outset of the expedition, all of the Army observers detailed to the Central Group were brought together at one point. This was at the side of the ships where an official photograph was taken of the Group. At this time we might summarize the location of the members of the observation group. The following members were left at the base camp: Major Crozier, Mr. Waite, Dr. Siple, Major Holcombe, Capt. Wiener, Col. Love, C. W. O. Morency, and Mr. Davis. Col. Johns, Sgt. London, T/5 Waltersdorf and T/5 Shimberg all sailed on board the *Mount Olympus*. Col. Davis and Capt. Harrison sailed aboard the *Merrick*. Capt. Harrison was detailed for weather studies aboard that ship. During this day the final preparations for leaving the ice party ashore went forward. Admiral Byrd moved ashore and Admiral Cruzen moved over to the *Northwind*. At 1930 the *Mount Olympus* broke her moorings and sailed out of the Bay of Whales, followed by the *Northwind*, *Yancey*, and *Merrick*. On this date visibility was very poor, the ceiling was low, and it was snowing. The tent camp had a population at this time of 197 men.

Maj. Holcombe:

By the end of the day a total of 350 linear feet of mat had been laid, and a double Quonset hut with four antenna poles had been completed at Little America. Forty-six Seabee personnel were left on the ice, all were galley personnel with the exception of 12 who were left to operate and repair equipment, maintain tent camp, complete connecting tunnels at Little America III, and conduct experiments.

C. W. O. Morency:

On 7 February the weather was overcast. It was 18° above zero F. and snowing with increasing winds.

Dr. Siple:

On the morning of the 7th, Lt. Dick Byrd, Jr., and Dr. Siple made a Weasel trip out to the barrier opposite the West Cape, and put in the first of two beacon markers, one being placed 100 feet back from the edge and the second one a measured distance of 300 feet back, headed at right angles to the west barrier wall of the Cape. These markers were to be placed for measurements of the movement of the cape. That evening a dog team party, including the three dog drivers under Boatswain Johnson and with Mr. Sparks and Mr. Sullivan, went across the bay, traveled to West Cape, and put in two additional markers in line with the ones on the east side, also 300 feet apart.

A conference was held in the evening to discuss the LVT trip to the southeast. This conference came to the conclusion that it would not be necessary to consider this as a gas cache primarily but rather as a weather station. It was hoped that the LVT's would be able to get out approximately 300 miles.

Mr. Waite:

It is now 8 February. The first major plane flight took place today. An R4D flew approximately 140 miles to the east and

another flew approximately 240 miles to the southwest to check weather conditions. This second plane was turned back by bad weather but the one that went east said the weather was O. K. in that direction inland, although it was still overcast at Little America.

Dr. Siple:

The flying conditions at the camp were not considered to be exceptionally good. However, the planes took off and landed successfully. This was a new era in types of flying in the Antarctic. On previous expeditions we had never dared risk taking planes off without CAVU weather in the vicinity. Admiral Byrd was introducing a new concept for flying which he said was "going after the weather," that is, to fly out with the planes in an effort to ascertain in what direction flights might be made.

C. W. O. Morency:

Capt. Boyd of the Marine Corps was still calibrating the compasses on both LVT-3 and LVT-4. We had to take five barrels of gas off the LVT-3 and seven barrels of gas off the LVT-4 in order to lighten up the sleds (original fuel load was 1,000 gallons).

Maj. Holcombe:

Comdr. Reinhart and Major Holcombe started making tests on the density and supporting power of the snow, the first one being on the roadway leading up to the mess hall.

Maj. Crozier:

Major Weir, U. S. M. C., took off in one of the R4D's with a total load of 30,000 pounds, using Jato. He was on only a short hop and upon his return had to circle quite a while in order to lighten his load before landing.

T/5 Shimberg:

T/5 Shimberg and T/5 Waltersdorf on the *Mount Olympus* reported that the *Burton Island* had left the *Mount Olympus* at 1015.

They saw their first sunset in 7 weeks at 2330.

Mr. Davis:

On 8 February Captain Wiener and Mr. Davis spent the day assembling the last wing on the OY. At this time a Herman-Nelson heater was obtained and the snow was melted from the fuselage and the wings. Several gallons of water came out of the right wing, almost a gallon out of the left wing, and enough water out of the fuselage to leave deep drip holes in the snow underneath.

Dr. Siple:

At the request of Admiral Byrd, Dr. Siple removed all of the emergency gear from one of the R4D's taken at random, examined the character and quality of the emergency gear, and weighed each item in order to get a complete list. It was discovered at this time that the food was very unsatisfactory in weight and quality, and changes were made to remedy this situation.

On 9 February the first aircraft took off for exploratory purposes. They headed south, starting at 1330. Admiral Byrd was aboard one of these planes. However, both planes had to turn back because of difficulties encountered. The plane in which Admiral Byrd was riding had a fuel leak at the main gas line when they changed tanks. The other plane got a vapor lock when the pilot attempted to change tanks.

Lt. Col. Johns:

The weather at Little America for 9 February was overcast 1,200 feet, visibility 12 miles, surface winds east-southeast 10 knots, temperature 14° F., barometer rising slowly.

Capt. Wiener:

The two aircraft that took off on the operational flight today had a gross weight of 31,000 pounds, which included 1,200 gallons of fuel. Upon completion of the flight

Admiral Byrd predicted that the planes would be able to get off with the use of Jato carrying a load of 1,600 gallons. Dr. Siple and Captain Wiener spent a good part of this day working over lists of the emergency food to be carried on aircraft on operational flights. As a result of this Capt. Wiener made a trip out to Little America for purpose of going through the old food caches at that base to secure additional amounts of pemmican, tea, and biscuits for the new emergency food rations.

Dr. Siple:

During the evening Dr. Siple and Captain Horney prepared the first emergency ration combined from the E ration, taking out what parts could be used and getting rid of all excess weights such as evaporated milk, coffee, prepared prunes, etc.

T/5 Shimberg:

At 0030 this morning the *Burton Island* transferred the mail over to the *Mount Olympus*, the *Merrick*, the *Yancey*, and the *Northwind*. On 9 February the sun came out, shining brightly over a perfectly beautiful scene for the first time since the R4D's arrived.

Lt. Col. Johns:

The Little America weather report for 0600 on 10 February was overcast of nimbostratus, continuous light snow, ceiling 900 feet, visibility 2 miles, surface winds north at 10 knots. Temperature 24° F., dew point 16° F., barometer falling. Outlook little changed in the next 12 hours. Flying conditions undesirable.

Maj. Crozier:

Today we had all kinds of weather. It was clear this morning, developed into quite a blizzard this afternoon, and then cleared up again in the evening. The wind changed direction completely several times during the day.

Mr. Davis:

This day the OY was moved from the hangar and the engine started up. The engine

operation was very satisfactory, starting directly from the battery with no difficulty at all. The engine started on the third turn-over. Taxi tests were made and found to be very good, but the steerable tail ski will be a tremendous advantage in taxiing. The snow was soft, the skis cutting in well, giving complete control of the aircraft at all times. Permission to fly, however, was denied by air operations.

Mr. Waite:

Installation of all radio equipment in the Quonset hut was completed on this day. Mr. Waite, in company with Lt. Nichols, U. S. N., the Airborne Electronics Officer of the camp, made a complete inspection of that station and then traveled to West Base, where another inspection was carried out.

Capt. Wiener:

On this date a flight of 2 C-47 aircraft took off on an exploratory flight to the southwest. Both planes flew southward approximately 240 miles until one of the aircraft developed engine trouble, necessitating the return of both planes to the base camp. The entire flight was made over an overcast and no ground whatsoever was seen. On the return to the base camp weather conditions were quite bad as a heavy wind was blowing, causing much drift. This necessitated several passes over the field by both aircraft before they finally made safe landings. Both aircraft managed to get in during a lull in the wind and very shortly after the landings the weather closed in tight,

Lt. Col. Johns:

On 11 February 1947 at Little America at 0700 the weather was as follows: Overcast, low clouds at 1,000 feet. Visibility 2 miles. Moderate snow. Wind S. E. 12 knots. Temperature 10° F. Barometer falling. Forecast—continued overcast and light snow, with increasing S. E. winds. Flying conditions undesirable, becoming bad late in the period.

Mr. Waite:

The Navy Type *TR* homing device was installed this day.

Mr. Davis:

No flying activity this day, due to the changeable weather and unfavorable predictions.

T/5 Waltersdorf:

Late the night of the 11th, as the ships of the Central Group were approaching the northern limits of the ice pack, the *Burton Island* knocked an ice flow into the *Merrick* and smashed her rudder stock—a solid piece of steel more than 12 inches thick. Later, the rudder fell off entirely. In order to repair her, it will be necessary to tow her to Wellington, New Zealand, 1,500 miles away.

Dr. Siple:

It became apparent that Captain Horney and Dr. Siple would need a great deal of help making up single emergency rations for the planes, because of the large quantities needed. Therefore, all of the flying personnel were called in to help prepare approximately 22 emergency rations. Two of these had been prepared before by Captain Horney, Dr. Siple, Capt. Wiener, and others. During this day materials were assembled. All of the *E* and *K* ration that could be located in the camp were brought to the mess hall. Capt. Wiener went out to West Base and brought back all of the biscuits and crackers that he could find that were suitable for trail rations. He recovered some dried foods and other substitute items for the ration. After the mess hall was cleared in the evening a group of approximately 35 flight, staff, and interested volunteers, including several Army observers, assembled in the mess hall. The *E* rations were opened and the desired cans of concentrated foods removed, opened, and the contents separated. At the same time, another group

opened *K* rations and took out all the biscuit combinations keeping them intact in their cellophane wrapper. Another group worked on weighing out rations, such as butter, cocoa, bacon, milk, etc. A final group assembled the supplies and packed them into parachute drop containers. The group worked with good efficiency and finished up the complete 20 rations at 1 a. m. The Army observer group had an active part in this operation. The work was carried out under the supervision of Dr. Siple. Lt. Col. Love assisted with weighing rations and calculated the caloric values. Captain Wiener, as previously mentioned, played an active part in assembling supplies.

Lt. Col. Love:

As finally prepared, the new survival ration was a 60-day ration instead of the 30-day type previously planned. The new ration represented a saving of 15 percent in gross weight and at the same time had an increase in caloric content of 8 percent.

The content of the ration was such that it was sufficient for subsistence for 1 man for 60 days, under conditions of only moderate activity. If conditions were such that heavy physical work had to be undertaken, such as moving on the trail, the rations were calculated to last one man for about 6 weeks.

In case the ration had to be reduced drastically in order to make it last longer, it was estimated to be sufficient for one man for 120 days.

Dr. Siple:

In each of the R4D planes one ration of this type was placed for each man aboard the plane. Three of these in each aircraft were fitted with parachutes so that they might be dropped to another plane in case of emergency.

Lt. Col. Johns:

The weather report for Little America on 12 February 1947 at 0100 was as follows:

X-ray weather. Overcast at 1,500 feet, continued slight to moderate snow. Visibility 1 mile. Surface wind, E.N.E. 8 knots. Temperature 24° F. Dew point 23° F. Barometer falling. Forecast—continued snow, with ceiling lowering 500 to 600 feet. Visibility ½ to 1 mile. Surface winds, varying to the east, 11–15 knots, increasing during the afternoon. Flying conditions undesirable.

Maj. Crozier:

At 1110 this date the mechanized trail party got under way. This party consisted of Captain Boyd and 1st Lt. Thompson of the Marine Corps, C. W. O. Morency and Major Crozier of the U. S. Army, Gunnery Sergeants Thomas and Bigelow of the Marine Corps, and Aviation Radioman Second Class McGovern of the Navy.

The party started out on a course of 84.5° true in a light snowfall.

C. W. O. Morency:

We were using an LVT-3 and LVT-4. Behind the LVT-4 we were dragging one Go-devil sled and an Army 1-ton sled with a two-sledge meter in the back to give us our mileage.

C. W. O. Morency was designated as one of the drivers of the LVT-4 and Major Crozier as medical officer and weather observer.

Mr. Davis:

This day marked the test flight of the OY. The first test consisted of 25 minutes with one landing. The aircraft was in good flying shape for further operations.

Three further ski landings were made in the evening.

It should be noted that for a civilian to fly military aircraft in a naval operating area the orders covering that civilian must have written into them proper jurisdictional meaning allowing flight of military aircraft.

Mr. Waite:

On the first evening of the trail trip, during the 2200 radio schedule, the operator

of the LVT tractor party tried to contact Little America using voice and a whip antenna on his TCS unit. This unit is a 35-watt unit on C. W. and 15 watts on voice. He was unable to contact Little America, though a careful watch was kept. The next morning he attempted again, using voice, and that time was heard for a short period of time and faded out after having given three messages. He then shifted to C. W. and tried again but was unheard. Later that afternoon he was heard to be 5 kilocycles off frequency at both NLA1 (base camp) and NLA, (Little America No. III) with fair signal strength. From that point on, it became necessary for him to use a horizontal long wire antennae and a 6430 kc. frequency instead of the ship and 4125 kc. antennae, and his communications remained very good until the return of the tractor party.

T/5 Waltersdorf:

Led by the *Burton Island*, the ships of the Central Group went steadily northward through the ice pack and then through "bergy bits" until they reached fairly clear water about noon.

Then they lay to at approximately latitude 67°54' south, long. 177°51' east. This is about 75 miles west-southwest of Scott Island.

Ships of the Central Group expect to stay in this area for about 3 weeks, until the *Burton Island* evacuates the men from Little America.

After laying to in this area, Admiral Cruzen transferred to the *Burton Island* and several correspondents and scientists came back to the *Mount Olympus* from the *Northwind*. Admiral Cruzen will go on the *Burton Island* back to Little America. On 13 February 1947, when the first freezing in the bay was observed from the air, seven whales were playing in one hole in the ice. Their motion apparently kept the ice from closing

the hole. It will be necessary to evacuate the base with one ice breaker instead of two as previously planned.

Lt. Col. Johns:

On 13 February the Little America weather report at 0700 was as follows: Overcast at 2,000 feet. Visibility 6 miles and light snow. Winds easterly 8 to 12 knots. Temperature 18° F. Dew point 17°. Barometer unsteady. Continued unfavorable flying conditions due to snow and low ceiling.

Maj. Crozier:

The tractor party continued its outward trip at 1145 this morning and covered a total of 44 miles during the day. This placed them at a point 66 miles east of the base camp.

Maj. Holcombe:

On the 13th, construction was started on ski runway No. 1. This was accomplished by tractors pulling drags running over an area about 100 feet wide, by approximately 4,500 feet long. During this time, density and Proctor needle tests were conducted to determine the characteristics of the snow. At this time it looks as though the combination of vibration and weight of the tractors do the larger part of the compaction. Sleds and drags apparently do not do as much as was previously thought. Rollers are also less effective than expected.

Dr. Siple:

In the morning, Captain Kosko called together the members of the scientific staff for a conference to describe their various activities to Admiral Byrd. Admiral Byrd became very much interested in the various projects and gave his assurance that he would do everything he possibly could to help them out with their program. He promised to give an opportunity for the airborne magnetometer to be taken on flights and to assist any of the groups that he possibly could.

Mr. Davis:

The science meeting fully discussed the obtaining of supersonic measurements and ice velocities, especially with regard to the ice samples that might be obtained from Seal Canyon.

The possibility of an expedition there was confirmed and agreed upon.

T/5 Shimberg:

The *Northwind* left the *Mount Olympus* at Scott Island today, towing the *Merrick* and accompanied by the *Yancey* at a speed of 8 knots. The *Burton Island* was to go to McMurdo Sound for scientific photographs and other observations. Scott Island was sighted at 2009.

The *Mount Olympus* is standing by at latitude 67° 24' south longitude 179° 55' west. Our last trip to the ice pack improved the condition of the propeller of the *Mount Olympus*. The tips of two blades had been previously bent in opposite directions. This time the ice straightened one and broke off the other.

T/5 Waltersdorf:

The *Burton Island*, which is sailing to McMurdo Sound, will be unable to make any of the special observations that the *Northwind* had planned to make because the equipment is not aboard her.

Dr. Siple:

It is necessary to cancel the trip of the personnel of the scientific staff and the observers who were to board the *Burton Island* and *Northwind* to McMurdo Sound. This is necessary because of the fact that all available space on board the *Burton Island* had to be reserved for the evacuation of the ice party.

Mr. Davis:

It was revealed on this day that no Geiger counter was available on the base for the anticipated special flights of the OY (Army L-5).

The OY. today made a total of four landings, two of them being on the newly dragged runway.

The snow surface of the repaired landing surface was at this time smoother than the landing surface.

The surface is getting harder progressively as the weather gets colder.

Capt. Wiener:

A flight of 2 R4D aircraft took off on the afternoon of the 13th in a southerly direction. The first of the two aircraft reached 87°20' south, 155° west. The second aircraft reached latitude 87° south and longitude 90° west, discovering a new range of mountains running northeast between latitudes 87° and 88°, about 15,000 feet high.

Dr. Siple:

Because of the complexity of reporting the R4D flights, which took off at various times of the day and overlapping various days, and many planes in the air at the same time, there will be no effort to keep these straightened out in this log. It will be appended as a separate log for all flight activities. Also, we are not attempting to report the activities and flying conditions of the Eastern and Western Groups for the same reason.

All the technical information is also deleted from this report for the most part and will be found in separate reports under subject headings.

Lt. Col. Johns:

On 14 February 1947 in Little America at 0100 the weather report was as follows: X-ray weather. Broken clouds at 5,000 feet. Visibility 30 miles. Surface winds east-southeast at 10 knots. Temperature -1° F. Dew point -2° F. Barometer rising. Continued good flying conditions for this period.

C. W. O. Morency:

At 1430 this day the Norseman plane, with Dr. Siple and Commanders McCoy and Dustin came over, landed, and had coffee

with us. Dr. Siple had a conference with Captain Boyd of the Marine Corps and discussed a few things concerning this LVT trip to the Rockefeller Mountain.

Dr. Siple:

Surface conditions in this vicinity were extremely soft, with fluffy snow on the surface, causing one to sink down halfway to his knees in the snow.

The plane landed on what appeared to be very smooth surface but encountered this deep snow.

We particularly wanted to describe to the tractor party the conditions of crevasses directly ahead of them and to check with them on what needs they might have, in view of the fact that radio communications with the party had not been too good up to this time. This was at the 66-mile camp.

Maj. Holcombe:

Two planes took off early in the morning, one at 0015 and the second at approximately 0100. They used the ski runway prepared on the evening before.

Mr. Davis:

The OY made four flights this day, totaling 5.20 hours. The first flight was the Navy photographers' flight for official pictures of the camp. Lt. Roscoe (U. S. M. C.) was flown for ice reconnaissance, especially in the Seal Canyon area. Lt. Stein (U. S. N.) was flown for official pictures of the R4D take-off, and Capt. Kosko (U. S. N.) was flown for a Seal Canyon reconnaissance.

Mr. Waite:

Several long exploratory flights were made on 14 February. They will be recorded later in the official flight log.

Dr. Siple:

The planes had some difficulty in taking off. The first plane got off successfully, but the second one took so much longer to take off that it was separated in flight from the first one. The reason for this was the fact

that it was frozen tight to the snow and timbers had to be worked under it. Because of this difficulty a new plan was devised, using plywood greased with Diesel oil, allowing the planes to break loose easily from that time on.

Mr. Davis:

During this same period the loading on the OY skis was such that there was no difficulty in taxiing and the airplane could be pulled loose by the engine with proper use of the rotor at any time desired.

C. W. O. Morency:

On the trail party trip, Major Crozier and C. W. O. Morency were selected to put the trail flags along the trail as they went along. Once when Morency was on the flag shift and was sticking a trail flag into the snow, the box, Morency, and trail flags all tumbled off the sled and the tractor continued on its way. Captain Boyd was busy looking at the compass, and looking forward. So about 3 or 4 miles down the trail they looked back and saw that they did not have trail flags, Morency, or a box. It was a good thing for Morency there was another tractor following behind to pick him up and take him over to the LVT-4.

Capt. Wiener:

At the request of Captain Wiener, aerial delivery tests were made for supplying stranded personnel with emergency equipment. A test today was made dropping two 5-gallon blitz cans with fuel for cooking stoves.

Mr. Waite:

The inspection of the radio equipment at West Base, the so-called emergency base, which was given some moments back in this record, should be changed to include a test transmission to Navy radio Washington. This was very satisfactory. Four different transmissions were made on frequencies between 4 and 20 megacycles using only 500 watts power at the Little America end.

Sgt. London:

A party tried to land on Scott Island today, Friday the 14th, but could not do so, due to violent heavy seas.

Lt. Col. Johns:

On 15 February 1947 at 0700 the Little America weather report was as follows: X-ray weather. High, scattered clouds, ceiling unlimited. Visibility 10 miles, surface winds south-southwest, 10 knots, temperature -7° F. Dew point -18° F. Barometer steady. Forecast—increasing high clouds, with ceiling lowering by end of period to 3,000 to 5,000 feet. Visibility 8 to 10 miles. Surface wind south 12 knots. Flying conditions average.

Maj. Crozier:

This is a continuation of the report on the LVT trail party. We got under way at 1845 on the 14th and continued until 1300 on the 15th, after having made a total run of 108.2 miles. This is the total mileage from the base camp. The temperature at 0200 this morning was -25° F.

Mr. Davis:

On this day the first major exploratory flight in which Army observers were present took off at 0215. Dr. Siple was in R4D No. 238 acting as navigator and Mr. Davis served as observer in aircraft No. 197. Each plane was loaded with 1,600 gallons of fuel to give a gross weight of 32,000 pounds. The flight headed eastward past the Edsel Ford Ranges and Executive Committee Range, and from there on, out into the unknown.

Dr. Siple:

The flight went over the Rockefeller Mountains, past Mt. Grace McKinley, and over Mt. Darling. These gave excellent ground fixes for the flight track and also cuts were made on Mt. Hal Flood. Dr. Siple served more or less as a pinch-hit navigator; because there had been so much flying there

were no navigators who had sufficient rest to go out with this particular plane, of which Commander McCoy was senior pilot. Dr. Siple was handicapped by not having been furnished a full supply of navigation equipment. He did not have a sextant or many of the usual navigating tools and had to use dead reckoning with a sun compass. However, Dr. Siple was fortunate in knowing the land, having had a responsible part in previous mapping of this area and was therefore able to identify the ground fixes without question. This phase is important in view of the fact that the planes traveled beyond the Executive Committee Range trying to reach the new embayment previously located by the Eastern Group. Beyond Mt. Ruth Siple, it was all new territory to Dr. Siple, with many new mountain peaks visible on to the eastward.

Upon returning, there was a question between the navigators of the two planes as to the exact location of some of the mountain positions. Both planes agreed reasonably well in the longitude of the turning point but differed by nearly a degree of latitude. In order to check their position Dr. Siple and Comdr. McCoy flew on a return course which permitted tying into old ground control stations.

Of particular interest was one mountain peak which has a rough elevation measurement of 20,000 feet. This mountain was conical in shape and looked very much as though it were volcanic in origin.

Mr. Davis:

As radar observer on this flight, Mr. Davis suggests that a complete log should be kept on flights in the future of the 718 altimeter, gyro precession rate, and navigational information as well as magnetic compass information.

It was indeed unfortunate that radar recording and radar navigation could not be exploited on this flight, as the planes could

have continued into unknown territory, which was lying under a low overcast.

The two aircraft returned to base after flights that ranged to approximately 10 to 10½ hours.

Mr. Waite:

During the first few long exploratory flights, plane-to-ground communication was attempted from the airstrip station on 4125 kilocycles and found so difficult that the frequency was changed to 6430 kilocycles. NLA1 at the new tent camp, the so-called Little America IV, was usually out of contact with the plane at any distance over 300 miles using a 100-watt A. T. C. transmitter. NLA, the west base or Little America III transmitter used 500 watts on the same frequencies with special antennae system, and had no trouble at all contacting the planes. The planes also used the air force type ATC 100-watt transmitter. This A. T. C. transmitter is the Army type ART-13. Noise levels at Little America IV, NLA1, were so high ordinarily, due to local generators, battery chargers, and lack of a ground connection, that it was impossible for this station to hear weak signals. The signals from the plane, even when 75 miles south of the pole, were heard well on the ship 700 miles out from the Bay of Whales, however. This noise situation at Little America became so bad that an SCR 694 was set up in a camp 300 yards from the nearest generator to check it but it was found there that the air was comparatively quiet so that from a pair of earphones connected to a battery operated receiver loud signals were heard all over the tent from all plane flights, from the ships 700 miles at sea, and several 6-MC. broadcast and code stations in the United States.

Lt. Col. Love:

It was at this period that the incidence of upper respiratory infection was noticed to be higher than previously experienced on expeditions to northern and southern high lati-

tudes. The explanation for this situation is not entirely clear. However, it is believed that the size of the party had something to do with it. Also the distribution of personnel, which involved some people living on the ships all or most of the time, while others were up on the ice shelf for most of the time. Contacts between these two groups were occurring sporadically and possibly this delayed the development of a group immunity.

Dr. Siple:

The following is a personal note from Dr. Siple in regard to his colds experiences. On the first three Byrd expeditions, colds were virtually unknown; only one or two men ever claimed that they had signs of one. However, on this expedition, Dr. Siple had a cold at the time the ship sailed, of moderate intensity, and did not actually get rid of it the entire time he was on the ice.

He believes that this greater increase in numbers of personnel as described by Dr. Love is a very important factor, as well as the continuous opening of supplies.

There was no opportunity in the short time on the ice probably to establish what could be considered group immunity.

Maj. Crozier:

Another factor in connection with the upper respiratory infections: a large number of personnel on the ice complained of dryness of the mucous membranes of the nose and throat, particularly in the morning. This gave rise to a feeling that one had a cold when actually it seemed to be more of an irritation of these mucous membranes.

Maj. Holcombe:

Construction of ski runway numbers 2 and 3 were started on this day.

Dr. Siple:

At 2315, two planes took off for the South Pole. Admiral Byrd was aboard one of these planes; Comdr. Campbell was aboard the other one.

Lt. Col. Johns:

It was on this date that Captain Dufek received his second dunking, when sudden and opposite rolls of the *Bronson* and the *Philippine Sea* parted the line supporting the boatswain's chair in which he was crossing from the *Philippine Sea* to the *Bronson*. He was readily rescued after approximately 8 minutes in the water. His first dunking was on the loss of the *Pine Island* helicopter.

Two PBM aircraft from the Western Group set down in the Shangri-la Lake water, which is a warm phosphate lake 200 feet above sea level, 5 miles from the coast, about 20 miles from the shelf barrier and 110 miles from the open sea. There were three large lakes and innumerable small lakes in this group.

Dr. Siple:

This area is located close to the Shackleton Shelf Ice not far from the exploratory routes of Frank Wild of the Mawson expedition. It is interesting that the descriptions of this region of a large area free of snow are similar to the one described by Griffith Taylor in the dry glacial valley named after him not far from McMurdo Sound, much farther to the south.

A great deal of discussion went on for days concerning this new discovery as a possible thermal region. However, there is no positive evidence to date that this region is thermal, other than that it is heated by the sun, causing the snow to be melted off. The lakes had a concentration of salt and other minerals. The temperature, however, was not beyond the range that could have been heated up by the sun itself. Had the region been volcanic there would probably have been very dense fog and steam in the region which would have made it more obscure, but such was not the case.

The area is quite extensive (20 by 30 miles), and would prove of tremendous interest if geologists could get in and examine the rock in the vicinity.

Lt. Col. Johns:

On 16 February 1947 in Little America at 0700 the weather report was as follows: X-ray weather—heavy fog, visibility 2 to 3 miles. Surface winds easterly. Temperature -16° F. Barometer falling. Little change with fog during the afternoon.

Dr. Siple:

At 1130 in the morning, the polar planes arrived back in the base. There was quite a bit of excitement at the time the first plane landed because the airfoil on the rear end of one of the skis became loose. They made several passes and the airfoil actually broke off. This airfoil is a wing section type structure at the tail end of the ski to keep the ski level, particularly during the period when it is raised from its landing position and retracted to the plane. There was no control over the up and down wobbling of the ski on this point, and therefore to prevent damage to the ski or plane it had to be stabilized. This stabilization airfoil, however, broke off at the time of the actual landing. The aircraft routes went up the Wade Glacier to the Pole, continued on for a degree past the Pole, and returned via the head of the Beardmore Glacier.

The heating arrangements inside the cabins of both planes were faulty and the men experienced a great deal of cold and some apparent anoxia. The temperature went down to approximately -40° in the planes at times.

Chief Boatswain's Mate Johnson and his dog drivers took a Weasel down to the bay ice during the evening to get seals for dog food. They attempted to cross the crack which has been described previously as a sheer crack where the second bridge was located.

When the sealers in the Weasel got to the location of the sheer crack where the middle bridge was located, they found the bridge completely disintegrated and strung along

the crack for a distance of approximately 75 feet. (This was due to the grinding action of the ice since the ships left.) They could not get across the crack at the point where the bridge had been and selected a new site. However, upon trying to cross it, they found that the ice would not support them in the middle of the crack and the Weasel went down into water. They did not have the plugs in the Weasel, which was the type that normally could travel in water, and it filled with water and sank.

Lt. Col. Johns:

It was on this day that the cable which the *Northwind* was using to tow the *Merrick* to New Zealand snapped in an 80-knot gale, leaving the *Merrick* at the mercy of the storm for several hours.

Maj. Crozier:

Continuation of trail party report: Got up at 12 o'clock today after sleeping for 20 hours. This sleep was badly needed by all on the trip. We washed our faces today for the first time since we left camp and spent the remainder of the day in reorganization, which consisted of building bunks and so forth in the tractors. Temperatures today ranged from -11° to -20° F.

C. W. O. Morency:

Today we tightened up all packing glands around the push rod housing trying to stop the bad leak on the continental engine which had used up to 40 gallons of oil in a distance of approximately 100 miles.

Mr. Waite:

Today, coded press from San Francisco 8,000 miles away was copied continuously for 2 hours without any noise background or other interference, on 6 megacycles, using a small battery-operated SCR-694 receiver. Also, several checks were made today on the 5-megacycle time signal from WWV in Washington with excellent results. These signals were unheard at the receiving station at Little America IV.

Mr. Davis:

Today the OY flew for approximately 3 hours and 30 minutes on one continuous flight to take Dr. Siple for reconnaissance over the ice around Roosevelt Island. The flight then continued down the coast to Lindberg Inlet, looking at the new cracks and the type of structure found there. The temperature ran as low as -28° C. at approximately 2,000 feet.

Dr. Siple:

This flight was of particular glaciological importance. The Bay of Whales area has been studied for over 100 years, but only within the past few years has the real meaning of all the tremendous cracks, pressure ridges, and valleys begun to be understood. Much of this has been done by photographs back in the United States, especially in studies by the National Research Council Committee on Deformation of the Ross Shelf Ice. The OY plane was particularly useful for ice studies because it could be jockeyed into position and returned over the top of places where special observations were needed. We found that practically everything fitted into the general picture of the tearing and ripping of the shelf ice as it passes on either side of Roosevelt Island. We visited the canyon country on the west side of Roosevelt Island, discovered unquestionably the location of the small island that was causing the ripping and tearing on the west side of the bay, found many new canyons and cracks that had formed in the Amundsen Pressure Arm, and went up over a portion of Roosevelt Island. On our trip out to Lindberg Inlet we found one crack that was running between 30 and 40 miles in length from the Bay of Whales out past the southern end of Lindberg Inlet.

Capt. Wiener:

The *Burton Island* is approaching the vicinity of McMurdo Sound.

Lt. Col. Johns:

Weather for 17 February at 1300 was as follows: X-ray weather. High overcast, lower broken clouds, visibility 10 miles. Surface wind southerly, 10 knots. Temperature -3° F. Dew point -3° F. Barometer steady. Increasing low clouds with snow and fog by morning. Surface wind southeast at 15 to 18 knots. Flying conditions undesirable.

Mr. Waite:

Early in the morning of the 17th, temperature at Little America was recorded at -22° .

Lt. Col. Love:

Information explaining the survival ration and its use under various conditions was gathered under the direction of Dr. Siple and prepared by Lt. Col. Love. It included suggestions made by various Army and Navy personnel who had had experience in the Antarctic in exploration by air, dog team, and motorized vehicles. This information, on three typewritten sheets, was turned over to Commander Hawkes, Chief of the base Aviation Section, who had it reproduced and copies inserted in the ration packs.

T/5 Waltersdorf:

The *Burton Island* has now reached McMurdo Sound and the U. S. S. *Sennett* is en route from Wellington to Tahiti. The helicopter from the *Burton Island* flew over Mount Erebus, which is an active volcano in the Antarctic.

Capt. Wiener:

Although it has been one month and several days since arriving in the vicinity of Little America and the start of putting up the base camp, the American flag was first raised over the camp today in appropriate ceremonies, with Admiral Byrd directing the ceremony.

Dr. Siple:

On one of the survey lines laid down by the 1939-1941 expedition, a pole was located which was believed to be on the base line,

but positive identification was desired. At the same time, by digging down to the canvas strips which had been laid in the snow, a good record of the amount of snowfall accumulation over the 6-year period since the strips had been laid could be obtained. Captain Wiener dug the hole down in the snow to a depth of approximately 8 feet. A similar pole was located at the other end of the base line which was very close to the edge. The sweep of the snow flowing over the edge of the barrier had prevented any accumulation on this point, and the canvas strips 6 years old were still lying practically on the surface with considerable melting around them.

Maj. Holcombe:

In this same hole that went down to approximately 8 feet, snow samples were taken approximately every 6 inches on the morning of Saturday 22nd. The last compaction work in dragging the three snow runways was completed about this date.

Mr. Davis:

The OY flew a total of 7.5 hours today. One of the flights was 4 hours and 10 minutes long, going to about 10,000 feet twice. This was to demonstrate the ability of the OY to stay in air for long enough period to fly 400 miles with a safety reserve. The snow surface is getting harder and ski operation is becoming rough on the newly etched surfaces. The snow surface is becoming hard enough in places that the OY ski keels only make marks. The flat surface bottoms on the skis quite often do not leave a trace of the airplane over the surface. The main drag runway is now considerably smoother than the average of the surface surrounding it.

Mr. Waite:

Two R4D (C-47) aircraft took off for long exploratory flight at 1050 and 1056, respectively. A third aircraft took off at 1121; a fourth took off at approximately 1315.

A fifth C-47 took off at 2100 and flew westward along the barrier. Lt. Commander McCoy, Lt. Roscoe, and Dr. Siple landed at 0143 on the 18th.

Dr. Siple:

This last flight was made at the request of Commander Hawkes who flew over the Queen Alexandria Ranges and had run out of film before reaching the embayment areas near the 180th meridian. The mapping flight started from Discovery Inlet going on out to just past the 180th meridian at approximately longitude 179° east. There were some evidences of increased activity in the bays. Between two groups of tension bays beyond Discovery Inlet, two valleys approximately 45 miles long running parallel to the barrier front were observed and photographed. On the return flight from Discovery Inlet to the Bay of Whales the aerial mapping cameras were turned on again, completing the central portion of the survey of the front of the shelf ice. A circle was made over the capes to tie in the photography that had been carried out early in the day, while the planes had to circle until the gas load was reduced to a safe landing amount. This was the fourth aerial survey made of the Bay of Whales area since 1928 and is of great importance for glaciological studies.

Mr. Waite:

One interesting point in the communication picture, between plane and ground, occurred when the fourth aircraft had trouble with one of its engines and was making a return flight to Little America. It was necessary to operate their ART-13 transmitter on 6430 kilocycles. Although they were requested by Little America to listen and operate on 414 kilocycles, they found themselves unable to do so because they had no extra transmitter.

Maj. Crozier:

Continuation of trail party report: Received message at 0430 this morning direct-

ing us to discontinue operations and return to base. Requested information as to whether or not cache should be established in this area. Later in the day we were directed to establish a cache at the foot of Mount Helen Washington in the Rockefeller Mountains. At 2245 started out on a course almost due north toward the Rockefellers over a course reconnoitered by Maj. Crozier and Capt. Boyd the previous day on skis. This was considered necessary because we were in a crevassed area.

Mr. Waite:

On several occasions it became necessary for some of the Army group to assist Jack Perkins, of the Game and Wild Life Service, in trying to locate seals which had been branded by numbers in 1935. On February 17th two of these seals, branded 12 years earlier, were discovered, numbers 183 and 11, down in the pressure ice 1½ miles southwest of Little America IV.

Lt. Col. Johns:

The weather report for 18 February, Little America, at 0100, was as follows: X-ray weather, low broken clouds at 900 feet, visibility 10 miles, surface wind south at 10 knots, temperature -14° F. Dew point -15° F. Barometer is still falling rapidly.

Maj. Holcombe:

It was the desire of Admiral Byrd to extend the landing mat-test strip still farther. On this date the mat was extended 180 feet farther, i. e., 40 feet wide only. This was tied onto the end of the 350-linear-foot strip, which was 150 feet wide. The mat-laying party was supposed to be volunteers, but due to the extreme cold and high wind there were only three volunteers available—Maj. Holcombe, Capt. Wiener, and Lt. Richardson (U. S. N.). The working party was composed of Seabee personnel.

Maj. Crozier:

The LVT tractor trail party continued west along a ridge south of the Rockefellers

to a point opposite Mount Helen Washington. Here they turned north toward Mount Helen Washington. This took them by the wrecked Fokker plane of the 1928-29 Byrd expedition. After a short stop here the party continued on toward Mount Helen Washington to a point about a quarter of a mile south of this peak. Here a cache of 72-octane aviation gasoline, E rations, kerosene, and trail flags was laid and marked by a large red flag on an 18-foot pole.

Following the laying of the cache the sleds from the No. 3 tractor were unhitched and all the personnel got into this tractor. This vehicle then proceeded up the glacier to the east of Mount Helen Washington, coming around in behind to a point on the saddle between Mount Helen Washington and Mount Franklin. Just before arriving at the top of this saddle a 10-foot crevasse was crossed. This crevasse was not seen prior to taking the tractor across, but while crossing over, the crust broke through and the crevasse could be seen below. A large number of rock samples were gathered from Mount Helen Washington. Boarding the tractor again, we proceeded up to the location of the camp of the seismographic station of the 1939-41 Byrd expedition and gathered rock samples from Mount Franklin. The seismographic station was also visited. The tractor had no difficulty in reaching this point. After visiting this site, we went back down to the point of the cache, picked up the other tractor, and proceeded back to the 88-mile beacon en route to the base camp. The food cache at the camp of the seismographic station was intact.

C. W. O. Morency:

Two marble slabs were retrieved from the old seismographic station by Captain Boyd of the Marine Corps to take back to the United States for a memorial to Captain Roy Fitzsimmons, who was killed during the war. At the top of a 10-foot 4- by 6-inch

timber, a flag was attached and a can was nailed to this board in which was placed a card with the names of all members of this trail party.

Mr. Waite:

Today the tests previously reported were made with MSS in Washington from the emergency base camp transmitter upon completion of two rhombic antennas, each of which was several hundred feet long per leg, one being used for transmitting and receiving and the two working together.

Sgt. London:

Two 50-caliber machine guns were broken out aboard the *Mount Olympus* today and several rounds were fired at flowing icebergs. This test was conducted so as to note the effects of the 50-caliber bullets upon iceberg ice. Sergeant London assisted the naval personnel in firing these two machine guns. The *Philippine Sea* has now arrived at Balboa, Canal Zone, en route to the United States.

Mr. Davis:

Today the OY flew 6.40 hours. First take-off was made with Lt. Stein for camp photographic scenes, taking off across the main drag snow runway, barely 100 feet wide, i. e., Davis made his OY take-off across rather than along the runway. Two ridges have formed along the sides of this runway; take-off was started atop the first ridge, and the plane was airborne before it could hit the second ridge. There was an approximately 20-knot head wind during this time with very lightly drifting snow. Two of the flights in the evening indicated that the seals were going underneath the ice in great numbers, less than 12 seals being definitely counted. Three landings were made in the rough névé away from camp to determine the ability of this type of ski to make landings on this type of surface in case rescue was needed. Landing aid

was established by using swing bomb technique with a heavy fishing weight on the end of the line, this line dragging on the ground before landing to indicate the roughness of the surface and to give an indication of the approach to the surface during lighting conditions which do not permit a pilot normally to see the ground. The air temperature at this time was about -22°C ., the temperature during the evening falling as low as -28°C . It is interesting to note that the skin on the end of Bob Davis' previously frozen fingers is coming off in patches now and the new skin is cracking badly.

Dr. Siple:

The good weather of the past few days has kept the R4D planes in the air much of the time. They have flown until the maintenance problem has become a bottleneck. Low temperatures have prevented the men from working efficiently, and it has taken them many more hours to do simple jobs than it would normally. Some casualties have occurred. One man had to be sent to the sick bay because of frozen feet, not too serious, however. During this period Dr. Siple has been working closely with Admiral Byrd in regard to general problems of the exploratory flights and plans of expedition work.

Mr. Davis:

Maintenance within the experimental OY hangar has demonstrated that any sort of structure that stops the wind very materially aids maintenance in this cold weather period, maintenance being fairly easy to accomplish. It is also suggested that infrared heating of men working might be a very valuable aid, especially where the wind can be kept from those men.

Lt. Col. Johns:

On 19 February 1947 the Little America weather report at 0100 was as follows: X-ray

observation, low scattered clouds, visibility 30 miles, surface wind south 5 knots, temperature -18°F ., dew point -20°F ., barometer falling. Forecast—continued good for the next 12 hours with little change in present conditions.

Maj. Crozier:

Trail party arrived back at camp at 1515 today after covering 88 miles in one continuous run. We started out at 2250 yesterday and covered this distance in 16.5 hours. The total speedometer reading for the trip was 245.1 miles. The trip back was rather uncomfortable due to the fact that the engine in tractor No. 4 was throwing a large amount of oil. The fumes were very bad in the tractor, necessitating the trap door be left open. It was a battle between the fumes and the wind.

As far as medical service on this trip was concerned, it was practically nil, consisting of two band-aids and one iodine swab. There were two minor cases of frostbite which required no treatment. These were on the faces of Capt. Boyd and Sergeant Thomas and resulted only in very slight swelling. The rations used on the trip were the *E* rations. This ration worked out very well. However, it is entirely too heavy to be carried on anything other than a mechanized trail trip. Clothing in general was satisfactory. Temperatures ranged down to -25°F . and averaged around -15°F . The main difficulty was with the feet, the remainder of the body being comfortable most of the time. With the drivers it was particularly difficult to keep feet warm because of the wind coming in around their feet in the cabs and the necessity of sitting still in one place for long periods. The shoe pac and ski boots both allowed the men's feet to get very cold. Also, there was considerable difficulty encountered in keeping one's knees warm. Several tricks were employed to overcome this. One was putting papers inside the windproofs.

Additional warm trousers were also used. However, none of these worked very well. While putting out trail flags from the box on the 1-ton sled, considerable difficulty was encountered in keeping our knees warm because our knees had to be drawn up tightly against us in order to sit in the box and still be able to place the flags. One means of combating this was to use the large fur parka which we had taken along primarily for use of the men putting out trail flags. Rather than wearing it we wrapped it around our knees. Morency used the fur gloves to put on his knees, holding the gloves down tightly against his knees, which helped some.

C. W. O. Morency:

On the night of 18 February, going into 19 February, returning from the mountains, Morency relieved Gunnery Sergeant Thomas of the Marine Corps as LVT driver. The trail flags were very hard to see. In fact, there were a lot of trail flags blown down and the old trail, at times, was also obliterated. At one time Morency got off the course by 200 yards and Captain Boyd of the Marine Corps happened to see a flag over to the starboard to which Morency immediately went and thus got back on course again. Sastrugi was in evidence and was holding the LVT-4 from getting up to higher gear; therefore, they had to drive from the 88-mile cache all the way back into camp in second gear, holding the LVT-3 down to a speed so that it would not run away from the LVT-4. While they returned from the 44-mile cache, they could see mirages of icebergs and the Ross Ice Barrier was as plain as if you had been standing out at sea and looking at it from the northerly to southerly direction. That was evident all day long. They got back to camp at 1515. Admiral Byrd was on hand to greet them. The LVT-4 had very bad oil leaks, and special tools with which to take care of such leaks were not available at that time. After returning to

camp they all went over to the mess tent to eat. Morency said he wasn't very hungry, but while sitting at the table he consumed a whole chicken. There were two different types of engines used on this trip, the LVT-3, using two V2 Cadillac engines at 110 hp. apiece, and a Continental with a 7-cylinder radial, air-cooled engine, giving 250 hp. The Continental engine had the bad oil leak. After the tractor party had returned, the radio equipment used was checked.

Mr. Waite:

It was found that the Navy type TCS transmitter was still in excellent operating condition. The SCR-694, however, that had been carried in canvas bags on the sledge roped down instead of mounted on shock mounts, as it normally would be in a vehicle, was found to have two broken tubes. The SCR-528 inside tractor No. 4 had one broken tube, which broke from the vibration of the vehicle only a few miles out, which necessitated cessation of all operations on that higher frequency throughout the remainder of the journey.

Dr. Siple:

On the morning of the 19th at the request of Commander Campbell, Dr. Siple joined Commander Campbell and Commander Dustin to make a trip down onto the bay ice to determine the thickness of the ice in the Bay of Whales, at the request of Admiral Cruzen. We found that the bridges at the sheer crack had completely gone and a new route had to be made through it. The bridge at the first pressure crack was still in fairly good condition and would be serviceable. At the bay ice a hole was dug down through the ice by means of a geological hammer and right near the edge of the old ice a thickness of 15 inches was obtained. However, out approximately 150 yards from the edge, a hole showed that the average thickness over the bay was only 9 inches. We traveled back across the new bay ice to

the edge of the barrier, where we were able to get samples of ice at the foot of the barrier at a safe point. Later, with the aid of Major Holcombe, this sample was found to have a density of about .65.

Mr. Davis:

The OY flew a total of 6.05 hours today, for Navy photographic purposes and to make contact with the tractor party returning to the base camp. Later an altitude test was made to see the altitude characteristics of the 100-octane gasoline used in a 72-octane rated engine. The test proved very satisfactory with relatively little loss of power due to the higher octane gasoline and the realization that the service ceiling of 16,000 feet could have been reached. Dr. Siple was transported to East Cape and then later out beyond west base, where a landing in the ice haze was made. The landing was made by directions from Dr. Siple to Bob Davis, the flags being the only visible distinguishable mark. Also, on this date, the effect of blowing snow and fence control for the clearing of the front of the hangar was made and gave interesting results which will be described in a technical report.

Dr. Siple:

On the OY flight out to East Cape, where we landed at the markers, measurements were taken of the displacement between East Cape and West Cape. The motion attributed to the northward movement of the west side of the bay was determined to be approximately 4.4 feet per day. This was interesting in view of the fact that it corresponded almost exactly with the same rate of motion east and west in the bay and also corresponded within a second decimal point of the same rate observed on the Ross Shelf Ice movement on the opposite side of Ross Sea, south of Scott's old camp. At Station B, where the second landing was made, an attempt was made to dig a hole down to find canvas at that point. We dug

a hole over 8 feet deep and still did not strike canvas. Unfortunately, conditions did not permit us to return and get a second measurement of snow accumulation. This pole was standing 7 feet at the surface when we first found it as contrasted to one previously described which Capt. Wiener dug out where only 2 inches of pole was sticking out. We have no record of original height of the pole. One point of interest regarding mirages was observed by Mr. Davis and Dr. Siple while we were at East Cape. The tent camp which had been in complete view during the whole time we were there at a distance of only about $2\frac{1}{2}$ miles away, suddenly had a degree of looming. The tent camp appeared to be extending up off the surface. We immediately picked up cameras to try to get a picture of it. The change had taken place when the sun had been suddenly obscured by clouds and a change in environmental temperature was apparent from where we were. By the time we had our cameras set up the looming effect became less pronounced. We noticed when we got down on our knees that the looming became even more pronounced and so we tried taking pictures at a height of only 1 foot above surface of the snow, where we could see the looming quite well. We were amazed, however, when we stood up, to discover that the tent camp was no longer visible. That means that the reverse of the looming, or a depression, was actually putting a normally visible object out of sight, whereas observation from a lower level made the camp stand up at an abnormal height.

Mr. Davis:

High speed movies were taken of this phenomenon. The landing at the East Cape was on either very rough or névé or newly formed sastrugi. The keels of the skis were all that showed marks in the snow except during the primary landing upon the crest

of a ridge. The airplane required about 480 feet to come to rest, power completely off after the initial contact. The ski marks were continuous from point of contact to point of rest, showing that there was no ballooning effect.

Capt. Wiener:

A second aerial delivery test drop was made today, utilizing a type cargo parachute known as a "baseball" chute. This chute, an 18-foot cargo parachute, is unlike the standard type personnel or cargo chute inasmuch as its canopy is of unbleached natural colored muslin instead of the usual silk, and on descent when in full blossom resembled a baseball in its fully rounded canopy rather than the umbrella effect of standard parachutes. The drop was made from a C-47 flying 85 knots at an altitude of 800 feet with a gross load of 95 pounds. Two and a half seconds elapsed from the time the kit and chute were kicked from the airplane until the complete opening of the canopy. Forty-four seconds elapsed from the time of the opening of the canopy until the kit itself reached the ground. The opening of this parachute was slightly eccentric, inasmuch as the parachute made what appeared to be a complete oscillation before it fully opened. At the moment of opening the drop kit was about 20 degrees above the chute. It was discovered that this was caused by the static line. The static line on this type of parachute is secured to the skirt of the chute rather than the apex. After opening, only one oscillation was observed. It is recommended that the Army Air Forces investigate this chute, described in greater detail in chapter 6, and that it be utilized in the Air Forces rescue squadrons.

Maj. Holcombe:

Completed laying the pierced steel plank of the landing field test strip. Now a total of 455 feet of the 40-foot wide strip has been laid. This is tied onto the end of the 350-

linear-foot strip which is 150 feet wide. The men working during the last 2 days laid approximately 125 square feet per hour per man. This excellent record (for Antarctica) was due mostly to the high morale and competition within the detail. One hundred and twenty-five square feet per man per hour is considered very good time.

Lt. Col. Johns:

On 20 February 1947 in Little America at 0700 the weather report was as follows: X-ray weather. Middle broken and lower broken clouds at 1,500 feet, visibility 10 miles, surface winds east-northeast, at 5 knots, temperature -5° F. Dew point -6° F. Barometer rising. Little change during this period.

Today the Eastern Group is steaming around Palmer Peninsula and headed for Weddell Sea.

A radio flash was received stating that the Chile and Argentine expeditions are carrying on surveys in Graham Land.

Mr. Waite:

On this day, V3 and V5 (C-47 aircraft) took off at approximately 1100 and landed at 1400. Communication was very good during this flight as indicated by the fact that code signals from England almost blocked communications at Little America.

V1 (C-47) took off at approximately 1700 and landed at 2016 after a flight to the Rockefeller Mountains and Roosevelt Island for geologist Balsley's first magnetometer test flight.

Today it was reported that of the four generator Jeeps carrying 28-volt, 300-ampere DC generators for raising the voltage of storage batteries in airplanes on airfields, all but one were out of commission, due to the fact that the electrical generators had been installed in vehicles which had been rebuilt and did not stand the test of hard wear and uses over a period of 1 month on Little America.

Dr. Siple:

The advent of the airborne magnetometer has brought a new tool of exploration into the Antarctic area. This device measures the variations in the magnetic field as the instrument passes above it. It is extremely interesting because on this flight, unbeknown to Balsley, he established confirmation of an island which had previously been located by inference on Dr. Siple's glaciological studies near Kainan Bay on the east side. His flight showed clearly when land was approached. He also confirmed the fact that Mount La Gorce was sedimentary, which was previously observed from the air in 1940 but never proven by actual contact. This new instrument will be extremely useful in future explorations to determine what lies beneath the snow mantel of the Antarctic continent.

Mr. Davis:

It is suggested that appropriate interconnection between the recording systems of radar and the magnetometer will give the most rapid way of surveying large areas and indicating the approximate type of structures and the relation of those structures to each other. It is further suggested that good navigational recording can make this a very rapid, complete method of survey of unknown continental areas.

Mr. Waite:

In connection with the magnetometer, discussion of the instrument with Mr. Balsley revealed that a small model is available which could be used for locating metallic objects under the snow at depths up to 50 feet with good results.

Maj. Holcombe:

Today the OY (Army L-5) was taxied over to the pierced steel plank test strip. Several landings and take-offs were made by Mr. Davis and apparently no damage was done to the mat, although the prop did

kick up a little loose snow. Later the plane was taken over to ski runway No. 1, several landings and take-offs being made there. The only damage noted was on one landing where the wheel seemed to burn the snow, leaving a mark the width of the tire, 2 inches deep; and approximately 10 feet long. This snow could be scraped out by hand. With the exception of this, the snow acted much the same as any normal soil-cement runway would have acted. Pictures were made by the Navy covering both of these experiments. Once, the plane was taxied while holding the brakes on one wheel to show the skidding effect. After the experiment the plane was taxied from the runway over the road leading to the plane's normal parking area. These tests were made with wheels on the OY instead of skis. This snow runway was partially compacted without any mat as a wearing surface.

Mr. Davis:

Today the OY was flown a total of 8.70 hours; 13 landings were made. Of primary interest were the operations from the pierced steel plank and then later from the snow airstrip. The take-offs from the steel mat were no different from ordinary take-offs and it was considered that a very strong cross-wind was in evidence. The mat, with the slight covering of snow that always splashes through the holes, had a feeling of being somewhat slippery, but the slipperiness was uniform and caused no pilot concern. The braking action on this mat was rather good during landings, with the exception that turn-arounds were difficult unless the tail wheel was steerable. The landings on the main strip were also easily made and in good order, giving no concern to the pilot. Turn-arounds were very good considering the fact that the steerable tail wheel was not operating. Braking action was good at high speeds, but tended to become slippery at slow speeds. No holes or evidence of bad

irregularities that would cause concern were encountered. Continued operation from a strip of this kind is deemed entirely satisfactory. The tire pressure on the OY was measured after the flights and found to be approximately 13 pounds instead of the ordinarily carried 45 pounds for this type of wheel. This low pressure was not greatly in evidence in any of the taxiing tests and the tires did not seem to suffer any damage. During all but the first two flights the aircraft was relatively heavily loaded, carrying in addition to the pilot a passenger and some baggage as ballast. The normal gross load of this aircraft is not to exceed 2,300 pounds. The first of these two take-offs was made at something less than 2,000 pounds due to no passengers. The later take-offs were made somewhere between 2,000 and 2,200 pounds, an absolute check on the gasoline not being made at the time but having added tools as baggage. The first two landings on the snow strip were made from power pull-ins resulting in full power stalls and minimum speeds landing with full flaps extension and full aileron depression.

Later, landings were made with wheel landings or not complete "power stall" landings. All landings were as would be expected on ordinary non-concrete surfaces. The landing gear of this particular airplane has a peculiar characteristic on concrete which is not in evidence on grass and was not in evidence here either.

Maj. Holcombe:

During the past 4 days the 50 tents which housed the personnel used 33 drums of Diesel fuel, which figures to be about 8.2 gallons per tent per day for their regular Quartermaster tent stoves.

Dr. Siple:

This is a comment on the survey activities in the Bay of Whales area: Commander Hidie located the site of the new magnetic station and ran a measured base line before

the ship had sailed. He located the site of this tent close to the base camp, at latitude $78^{\circ}25'13''$, longitude $163^{\circ}54'04''$. His base line is 972.36 meters long with an azimuth of $166^{\circ}16'33.5''$. Today Lt. Shoenie (U. S. C. & G. S.) and Capt. Wiener went over to Little America III and located the 1940 expedition's Station A, which had presumably moved due to glacial activity nearly a mile and a half westward since the date that it was put down 6 years ago. Its original location was at latitude $78^{\circ}29'06.1''$, longitude $163^{\circ}50'10.1''$ and the azimuth of the base line was 180° true.

Lt. Col. Johns:

The helicopter flying from the *Burton Island* made a forced landing in the vicinity of Scott's 1902 camp at McMurdo Sound and the crew used a sledge, found there, to get the spare parts required to repair the rear rudder of the helicopter. They also investigated Scott's Cape Evans 1911-12 base and Shackleton's 1915 base at Cape Nimrod.

Dr. Siple:

It is interesting to note that in the hut visited a calendar was found on the wall with a date of 1931. This possibly indicates that a visit was made by the crews of the *Discovery* II expedition. However, the occurrence of this is not quite understood. The group that landed went into the camp and also collected rock samples from the terraced slopes of Mount Erebus and Mount Terror.

Capt. Wiener:

At 7 p. m. on this day the *Burton Island* departed from McMurdo Sound for the Bay of Whales. It is interesting to note that although today is 20 February here in Little America, at McMurdo Sound, west of the 180th meridian, it is 21 February. It is also interesting to note that McMurdo Sound is less than 400 miles from the Bay of Whales.

Mr. Davis:

On past OY flights for ice reconnaissance, the peculiar way in which cracks form next

to large crevasses has been noticed. These cracks seem to run vertically across the bottoms of the crevasses and always maintain a rectangular appearance. The side, when it breaks, instead of forming a V-shaped side maintains a side in a vertical plane. Today the OY was flown close to the water below the edge of the barrier in search of further evidences of this kind. It was revealed that this cracking structure occurs along the outside barrier, and accounts for the sheer vertical cliff that is encountered there. The cracks running into the barrier perpendicularly also reveal many of these same characteristics.

Lt. Col. Johns:

On 21 February 1947 the Little America 0100 X-ray weather observation was as follows: Low broken clouds at 3,000 feet, visibility 12 miles, surface winds to east 10 knots, temperature 8° F., dew point -2° F., barometer rising. Forecast—continued good for the next 12 hours.

Dr. Siple:

The sun last night dipped below the horizon to the south at midnight, local time. For the past few days it has been approaching the horizon, the lower limb disappearing behind Roosevelt Island.

Mr. Davis:

Today the OY was flown a total of 4.30 hours. The primary flight was that of taking Lt. Stein (U. S. N.) up to the ice cracks, to Amundsen Arm, for a low level ice picture reconnaissance. It should be noted here that future aircraft of small dimensions coming down here should carry shoulder straps for safety in case of forced landings among rough ice or crevasses. During the OY flights of the 20th and 21st, seals were noted well back in the cracks several miles inland from Seal Canyon.

Dr. Siple:

Today Commander Reinhart, Major Holcombe, and Dr. Siple made a trip down to

the bay ice to reconnoiter a route for the tractor trail to the *Burton Island* when she arrives. The cracks at the top of the barrier had widened considerably, having an average width of close to 2 feet. A place was located close to the old tractor trail where there was a double break with two cracks each averaging a foot wide. Some change in the bridging construction over this will be necessary. We went down to the sheer crack and had to locate a new passage over it which would require bridging, but at the first pressure ridge the old bridge was still in good condition despite the fact there were a few drifts over the top of it. There was no active pressure in the immediate vicinity, though 100 yards from it pressure was extremely active and had made great changes since the bridge was first put in. The rest of the route out to where the ships will anchor was over bay ice with a few new cracks in it, but nothing of serious nature. A carefully laid flag trail was marked all the way back.

Maj. Holcombe:

These cracks were bridged later on during the evening.

Lt. Col. Love:

After several flights, aircrew members reported symptoms of acute anoxia at altitudes of 12 to 14 thousand feet and several stated that they had never experienced so much difficulty flying without oxygen at the same altitudes during the war. Today a flight was authorized and was made by Lt. Col. Love for the purpose of checking six subjects at 13,500 feet, indicated altitude. The results were within the limits of what would be anticipated in lower latitudes.

Capt. Wiener:

A third aerial delivery test drop was made today using a home-made well-padded container and a home-made 12-foot parachute. This unit was for the purpose of aerial deliv-

ery of a handy-talky SCR-536 radio to supposedly stranded personnel for the purpose of establishing immediate air-ground communications. Upon throwing the unit out of the C-47 aircraft at an altitude of 800 feet, the canopy caught on the tail ski of the plane, where it hung for about 30 seconds and then fell clear. The parachute did not blossom forth but rather streamed the entire 800 feet. Upon retrieving the handy-talky set, tests were made for damage by calling the base operations radio. The first attempt of making contact failed, but contact was finally made at a distance of approximately 45 feet.

Mr. Waite:

This bears out other tests made with this unit on the ice. At temperatures of 18° above zero checks were made at all distances from 200 yards to 800 yards. The batteries used in all of these sets carried by the Navy at this time were dated 1944 and voltages on all of them were low before they were subjected to cold weather operation.

Capt. Wiener:

For information purposes, the C-47 and R4D are one and the same type airplane, and for further information the R4D's on this operation were of an old vintage and had been used considerably during the war period.

Dr. Siple:

Locally the weather was fairly good most of the day. There was some clear sky off to the southwest. However, the weather forecast did not bid well for extensive flying. The main flying on this day was by Lt. Warden (U. S. N.) who took Balsley south over Roosevelt Island with an aerial magnetometer, taking one island off the map and confirming a doubtful island.

Capt. Wiener:

The third parachute jump on this operation was made by a Navy parachute rigger,

Marvin D. Sprake. Major Weir (U. S. M. C.), in an R4D plane, made an ice reconnaissance approximately 180 miles northwest off the Bay of Whales for the *Burton Island*, which is en route to the Bay of Whales from McMurdo Sound.

T/5 Shimberg:

The *Northwind*, *Merrick*, and *Yancey* reached Dunedin, New Zealand, at 2200 today.

Lt. Col. Johns:

On 22 February 1947 the Little America 0100 weather report was as follows: X-ray weather. Broken clouds at 5,000 feet—low or scattered at 2,500 feet. Visibility 10 miles. Surface winds 10 knots south. Temperature 10° F., barometer rising.

Dr. Siple:

At about 0500 this morning two R4D's took off for the southeast. Dr. Siple was observer aboard one of these planes, and Captain Horney was observer aboard the other. The purpose of this flight was to travel toward the southeast to determine the exact trend of the Horlick Mountains of the Queen Maude Range. In previous flights, there was a discrepancy in two trends that were reported by other flights. One of these indicated the trend running toward Caird Coast and the other toward Palmer Peninsula. It is possible that these two may be separate mountain trends; however, the descriptions tallied so closely that a question of navigation was brought up. However, the flight was turned back by heavy weather to the east, southeast, and to the south. We reached latitude 85°30' near the mouth of Thorne Glacier and had to climb to over 14,000 feet with bad weather still ahead. Due to anoxia condition of some of the pilots, radio operators and navigators, it was impossible to proceed. On the return trip the plane in which Dr. Siple was riding turned east toward a clear area and a mapping reconnaissance was made of the southeast corner of Prestrud Inlet. As we arrived

back at the base the plane carrying Balsley out to make a magnetometer survey of the Edsel Ford Range was reported in trouble. This plane had reached close to the vicinity of the Rockefeller Mountains about 100 miles out from Little America. One of the engines cut off completely and they had difficulty trying to feather the prop. In the process of trying to feather it, and to prevent losing altitude, they began to lighten the load of the plane and threw out the aerial mapping camera. The crippled plane returned along the still visible tractor route. The plane in which Dr. Siple was riding went out to meet the other plane, getting sight contact near Kainan Bay. The crippled plane came in and landed without incident. The plane in which Dr. Siple rode made its landing after about 12 hours in the air. The landing of these two planes virtually ended the entire flying program at the camp. The *Burton Island* had arrived in the bay, creating great excitement, and immediate evacuation was planned.

C. W. O. Morency:

The LVT-3 left the mess hall at 0800 with Admiral Byrd and the Base Commander, Commander Campbell, to go aboard the *Burton Island*. On the way to the ship the LVT-3, too wide to use the bridge at the sheer crack, tried to cross it at another point. This spot was very weak and the LVT-3 broke through. It was afternoon before the LVT-3 could pull itself out by two 1½-inch cables tied to its own tracks and using a "cat" as a deadman.

Mr. Davis:

The 3.10-hour flight of the OY concluded the flying of the OY, a total of 58.40 hours having been flown. A final survey of the hangar showed that intelligent use of snow fences and snow blocks can make a hangar feasible, especially the entrance to the hangar can be kept in an inclined shape with relatively little or no shoveling.

Mr. Waite:

Due to considerable discussion regarding the change of signal strengths and various background noises in the communication set-up at Little America III and IV, it was believed that a properly designed antenna system with low power would accomplish the same degree of communication perfection accomplished by the larger transmitters used with their imperfectly designed antennas. Permission to transmit to the *Burton Island*, a distance of 200 miles, was therefore obtained at midnight on 21 February, and an attempt to contact that ship at 0120 on the 22nd with a 10-watt hand generator driven transmitter received a very good signal strength report. On investigating the log of the *Burton Island*, it was found that the U. S. S. *Mount Olympus*, which was using the same call, was the ship that had made the signal strength report at a distance of 700 miles from Little America.

Capt. Wiener:

For a short period before midnight and shortly after midnight tonight, there was a very beautiful sunset, casting a pink light on the snow.

Dr. Siple:

When the *Burton Island* came into the Bay of Whales through the new bay ice, it was interesting to see that she cut only a very narrow path just a little wider than the ship. The ice did not break up in the same fashion as when the *Northwind* attempted to empty the ice out of the Bay of Whales at the beginning of the operations. The ship rode onto this ice, which had a rubbery texture, and broke it down. The ice hardly impeded the ship as she came in or went out of the bay.

Some time ago it was mentioned that on one of the bad weather days the seals had apparently disappeared from the bay. However, this should not be considered as the final disappearance, because on the next good day many seals were out again. During

the period in which our activity was transferred down to the bay around the ships many seals were found out on the ice in new locations. Some of them were moving northward toward the newer cracks within a mile or two of the open water.

Mr. Waite:

While trying to rephotograph the numbers on the two branded seals which had been seen previously, we counted over 200 other seals on the bay ice during the last 3 days we were at Little America.

T/5 Shimberg:

The *Northwind* left Dunedin, New Zealand, to go back to Little America to help the *Burton Island* evacuate Little America.

Lt. Col. Johns:

The *Currituck* proceeded 1,500 miles westward and two flights were made over Prince Olaf Land and Princess Ragnhilde Land. It was interesting to note that tenders can service planes without the facilities of a sheltered harbor.

Mr. Davis:

During the process of cutting snow and ice for the supersonic test, it was noted that blocks in the order of 6 to 8 inches square and several feet long had a peculiar musical ringing note to them. These blocks changed their ringing characteristic very markedly upon changes in temperature and it is thought they changed with relation to time. On a cold day when you could hear your feet squeaking on the ice surface these blocks would have a different characteristic note than they would on ordinary days. The tone was markedly changed from when they were first cut.

Very rapid chaotic measurements were made during the last few hours by other supersonic equipment for the measurement of attenuation. The results of these measurements may have significance; they should be noted in the Technical Naval Research Laboratory Report.

Lt. Col. Johns:

On 23 February in Little America the 0100 weather report was as follows: X-ray weather. High scattered and low scattered clouds, ceiling unlimited, visibility 30 miles. Surface winds southwest, 5 knots. Temperature 3° F., dew point -1° F. Barometer rising.

Dr. Siple:

This is the official evacuation day and although many programs are still being actively carried on, most of the activity is centered around packing up of individual equipment and getting everything sent aboard the ship as rapidly as possible. Because of the limited space and hold capacity very little equipment of heavy nature is being returned, and such items as the R4D planes, the OY, and much of the heavy scientific instruments and equipment is all being abandoned on the ice. An effort is being made to establish markers on the caches to locate these. Lt. Chaney has made an effort to tie in some of the areas to his base line and Commander Campbell made a flight with a JA late in the evening of the day before to photograph the area for a final time to locate where the different caches are left, so that if they are covered up they may still be available within the next 1 or 2 years.

Maj. Holcombe:

An R4D on wheels weighing approximately 20,000 pounds was used to test the pierced steel plank, the snow runway No. 1 and, thanks to Admiral Byrd, the roadway leading to the mess hall. These tests started during the evening of the 22nd and lasted until the afternoon of the 23rd. The snow base beneath the pierced steel plank definitely failed, leaving the mat bent up to about 2 inches. The snow runway seemed to be compacted slightly less than normal. The roadway definitely held the plane the same as any concrete runway and the only

tracks remaining were those made by loose snow in the tire treads. These tests were well covered by still and moving pictures which should definitely prove to higher authorities that airfields can be built on this type of snow.

C. W. O. Morency:

Today the LVT-3 and LVT-4 were driven over to the Quonset hut at the emergency base camp (Little America III). The oil was drained out of the crankcase of the LVT-3 and the radiators of the LVT-3 were drained, but not the transmission. The LVT-4 was not drained for the reason that if anyone was to use the LVT-4 later on he would have to put in a complete new engine. The two LVTs are located on the northwest corner of the Quonset hut and each of the LVTs has a flag tied to the antennas. The batteries were not disconnected.

Capt. Wiener:

Today the *Mount Olympus* left the vicinity of Scott Island for the purpose of scouting the northern edge of the ice pack to provide the *Burton Island* with latest information on ice conditions in this area.

Dr. Siple:

The Western Group is beginning to wind up its exploratory observations and hopes to make one more trip to the "Bunger Oasis." The Eastern Group is heading for the Weddell Sea, still with hopes of making a final reconnaissance in that area. The weather has been so bad recently that the group has not had a chance to launch flights after reaching that area.

Mr. Davis:

The OY's had their wings and tails removed today. Wings and empennage were removed to the Quonset hut for storage.

The batteries were removed and put directly under the aircraft with the tools. One fuselage was left within the hangar structure, the other one being securely tied down and loaded with gas barrels immediately in front of the hangar. Markers about 20 feet in length were placed beside both of them marked "OYL5G.2."

Mr. Waite:

At 1800 on the 23rd, a last trip was made to Little America II. Ten men redug the tunnel and left the opening covered by a tarpaulin, marked by a 16-foot high plank on which is written identification.

As the last heavy duty tractor pulled its sledge from the camp down to the *Burton Island* the sledge fell in the crevasse when the tractor did not go over the bridge directly but tried to go to the right hand side of the bridge. The sledge stopped abruptly in the crevasse, the cables broke, and two men were thrown off, but eventually this sled was recovered with all of its baggage.

Dr. Siple:

In the late afternoon Admiral Byrd made his first and last official visit to West Base and the Quonset hut of Little America IV. He entered the building, although it had already been secured, went down and visited all the various buildings beneath, and resecured the buildings. In the evening the final packing was completed and most of the personnel had evacuated from the base. Admiral Byrd with W. O. Morency, Dr. Siple, Lt. Comdr. Dustin, and Lt. Comdr. McCoy were among the last men to leave the base.

Admiral Byrd left a note in his Wannigan hut and then proceeded to the flag pole, where he saluted the flag and then departed from the camp site for the ship.

INSTRUCTIONS FOR OBSERVERS

OPERATION HIGHJUMP

ANNEX K TO COMMANDER TASK FORCE SIXTY-EIGHT

OPERATION PLAN NO. 2-46

INSTRUCTIONS FOR OBSERVERS

1. The Task Force Commander wishes to take this opportunity to welcome all observers aboard ships of the Task Force. Everything consistent with the primary mission and overall success of Operation Highjump will be done to afford all observers the opportunity to perform their special duties and to promote their health and comfort.
2. All military and civilian observers participating in the Highjump operation will be ordered by the agency controlling their services to report to the Commander Task Force Sixty-Eight for duty. The Task Force Commander will assign each observer to a ship of the Task Force for transportation, quartering, and messing. At the completion of duty with Operation Highjump each observer will be ordered to return to his regular duty station or to carry out the uncompleted portion of his basic orders.
3. The Task Force Commander will, through the Projects Coordinator and other appropriate members of his staff, exercise general supervision and coordinate projects as required to avoid duplication of effort and to take maximum advantage of available equipment and opportunities to collect scientific data and other information of value. Commanding Officers of each ship will supervise and coordinate projects on individual ships as required.
4. A complete and detailed report of this operation will be compiled upon its completion. This report will be given wide distribution and all agencies participating in Highjump will receive an appropriate number of copies. In order that the report will be as complete and comprehensive as possible, observers will submit their official reports to or via the Task Force Commander. If desired, observers may submit advance copies of their reports to interested addressees. The Task Force Commander will be informed of advance copies so distributed.
5. Messing:
 - (a) In general all passengers will subsist in the same mess as those with

whom they berth. There may be some exceptions to this policy depending upon the facilities available.

- (b) All passengers messing in a wardroom mess will be required to pay a mess bill to the treasurer of the mess in which they eat. This bill will be the same as for other members of the mess.
- (c) Civilians may be authorized in writing to eat in a general mess at the temporary base by the individual commanding officers. In these cases, the civilians who eat in this general mess will be required to pay 70 cents per day. This money will be paid to the commissary officer at the end of the trip, or at the end of each month as appropriate.
- (d) Army enlisted personnel will subsist in the general mess of the ship on which they are embarked. The commanding officer of each ship will authorize in writing the subsistence of Army personnel and the carrying of such personnel as supernumeraries. The Army officer or non-com in charge will be required to certify that subsistence was received.
- (e) The Marines embarked will subsist in the appropriate mess. No special conditions surround the messing of Marines.

6. For some observers this operation will mark their first experience at sea. The following points are listed for information:

- (a) Personnel accommodations will be crowded on some of the ships. All available space will be utilized in order that there need be no limitation on number of personnel participating in the operation. It is hoped that observers will realize the necessity for crowded conditions, where existing, and will make the best of the situation. The individual assignment of quarters and messing will be made by the commanding officer of the ship to which the observer is assigned.
- (b) Conserve food and fresh water. The supply is ample, but waste must be avoided.
- (c) Do not hesitate to call on personnel of the staff or vessels of the Task Force for information or to make suggestions for improving the conduct of the operation.
- (d) It must be realized it will be necessary for commanding officers to impose certain restrictions to insure success of operations, for the safety of personnel and material, and for the general health and comfort of all hands.

7. It is expected that ships of this Task Force will visit foreign ports during the operation. Consequently civilian observers are advised to obtain passports prior to departure. Visas should be obtained as follows:

Central Group—New Zealand.

Panama.

Eastern Group—Brazil.

Panama.

Western Group—Australia.

New Zealand.

8. All personal mail should be carefully addressed to the individual concerned, giving the name of his ship in care of Fleet Post Office, New York.

Example:

Mr. JOHN ROBERT SMITH
U. S. S. MOUNT OLYMPUS
Care of Fleet Post Office
New York, N. Y.

FACILITIES ASHORE AT LITTLE AMERICA

COMMANDER TASK FORCE SIXTY-EIGHT

CTF68/L24/pk U. S. S. MOUNT OLYMPUS (AGC-8)

c/o Fleet Post Office

New York, New York

27 December 1946

MEMORANDUM TO ALL OFFICIAL OBSERVERS:

Subject: Facilities Ashore at Little America.

1. The primary objective of the Central Group, Task Force 68, upon its arrival at the ice shelf is to construct in the shortest time an airstrip for the operation of aircraft on wheels. Therefore, all available subsistence facilities ashore will be required to accommodate personnel actually engaged in the construction of the airstrip and related facilities required for the operation of aircraft.

2. Observers whose special qualifications can be utilized to expedite completion of the air facilities and who volunteer to become a working member of the organization under the Officer in Charge of the base in connection with the construction of these facilities will be assigned appropriate quarters ashore during this period. Observers desiring to avail themselves of their opportunity should make such arrangements with the Officer in Charge of Construction (Commander C. O. Reinhardt (CEC)).

3. When aviation facilities have been completed, quarters, materials, and construction personnel will be employed to provide facilities and assist with other approved projects. Until the aviation facilities have been completed, no individual or group will be authorized to procure or erect their own facilities and then only upon approval of the Officer in Charge of the base.

4. Approved plans provide for utilizing the facilities established by the U. S. Antarctic Service in 1939-1941 to supplement the temporary tent camp if they are found serviceable and later to rehabilitate them to serve as the 35-man emergency camp. Until rehabilitated, personnel not engaged in the rehabilitation are prohibited from disturbing or entering the buildings of the former camp.

5. As soon as the *Northwind* can be released, after arrival at the shelf ice, and if unloading of the AKA will permit access to the Automatic Weather

Station, it will be set up in the Victoria Land Area, using the *Northwind* for this purpose subject to facilities being available. It is suggested that members of the following organizations accompany this trip.

- (a) U. S. Geological Survey.
- (b) U. S. Fish and Wildlife Service.
- (c) U. S. Coast and Geodetic Survey.
- (d) U. S. Hydrographic Office.
- (e) U. S. Weather Bureau.
- (f) Three correspondents.

6. Personnel desiring to make this cruise should inform Captain G. F. Kosco.

7. General.

- (a) Facilities for aerological observations will be erected along with other air operating facilities. Quarters for aerological personnel will be provided for five men and one officer.
- (b) If the magnetometer station can be located near the Quonset hut at the airstrip, one of the unassigned tents and 110-volt AC current can be made available. Unless a small gasoline driven electric generator can be procured from existing electronic or BuAer equipment, it will be impossible to provide 110-volt AC current for this purpose at an isolated site.
- (c) Airborne magnetometers will be fitted and flown in R4D's when opportunity permits.
- (d) Provisions will be made, upon the completion of the airstrip, for equipment, transportation, and living space for use of observers to make exploration trips, observations at airstrip, and other programs outlined in their memoranda to the Chief of Staff. It is estimated that these operations can commence about 1 February 1947. In the meantime ample opportunity will be afforded all observers not actually engaged in operations as mentioned in paragraph 2 to visit shore activities, as tractor trains will be leaving and returning to the strip at frequent intervals.
- (e) Local flights for observers will be permitted dependent upon requirements, operating conditions, and work load.
- (f) Decisions regarding extended flights will be held in abeyance until the R4D's arrive and conditions are evaluated at that time.

8. It is earnestly believed that everyone will have ample opportunity to observe all conditions necessary to completing his mission and to carry out all programs as now anticipated. Some of these programs may be delayed until completion of the airstrip, so your patience is therefore requested.

R. H. CRUZEN
Rear Admiral, USN
Commander Task Force 68

QUARTERMASTER QUESTIONNAIRE

FOR NAVY TASK FORCE 68

The following are answers to the QM questionnaire for Navy's Task Force 68, Operation Highjump, Naval Antarctic Development Project, which was presented to the Army observers by Col. Richard L. Lewis of QM Research and Development Branch. Answers to the questions listed below were supplied by the Army observers at a round table discussion conducted by Dr. Paul A. Siple, Senior War Department Observer, while the group was in the Antarctic regions.

1. Cream, Sunburn, Preventative.

a. Does it provide adequate protection against sunburn?

The sunburn cream proved very effective in preventing sunburn. It was observed, however, that a need for the cream existed only during the initial period of tanning.

b. Has there been any indication of skin irritation caused by use of this cream?

There was no indication of any skin irritation as a result of the use of the sunburn cream.

c. Is its effectiveness materially reduced by perspiration?

There were no observations made on the effectiveness of the sunburn cream during periods of perspiration.

d. Does it rub off easily and soil the clothing adjacent to where it is used?

There was no evidence of the cream rubbing off and soiling adjacent clothing.

e. Is its invisibility on the skin an asset, or would it be more desirable to have a

colored cream so that its presence could be easily observable?

The concensus among the Army observers was that the invisibility of the cream is a definite asset.

f. What are the relative advantages and disadvantages of this cream compared to the sunburn preventative cream supplied by the Navy as regards performance, comfort, acceptability, and packaging?

Standard Navy sunburn preventative cream was not issued to members of the Task Force. The shore dispensary issued lanolin ointment to prevent sunburn during the first few days ashore.

g. Is the cream difficult to remove after prolonged period of use?

Adequate washing facilities were available and no difficulty was encountered in removing the sunburn cream.

h. Does it cause the skin to become soiled more quickly?

It is believed the cream tended to make the skin soil more quickly.

Note. The Army sunburn preventative cream was used only by a limited number of Army personnel.

2. Tray, Mess, Six-Compartment, Plastic.

The plastic trays were not used by the Task Force. The shore party operating on the ice barrier were equipped with steel mess trays and used them throughout the entire period ashore. It was observed that the steel mess trays when used in the mess tent caused the food to cool rapidly, resulting

in the last half of the meal being eaten cold. This deficiency was overcome somewhat by preheating the trays on top of a stove in the mess tent before the food was placed on it.

3. Bag, Clothing, Waterproof.

a. Does the bag become stiff enough at low temperatures to interfere with proper use and functioning? At what temperature does this stiffening occur?

Temperatures encountered during the operation did not cause the bag to stiffen.

b. Does the waterproof coating on the bag show any tendency to crack when flexed repeatedly at low temperatures or when folded, subjected to pressure, such as occurs during packing, and then unfolded at low temperatures?

These difficulties were not present.

c. When the bag has been wet and then frozen so that it is coated with ice, does flexing and folding cause the coating or fabric to crack, tear, or separate?

No such difficulties were experienced.

d. Does the bag remain waterproof under all conditions of service? Is there any tendency to leak at seams or closures?

The waterproofness and the closures on the bag proved satisfactory for the uses to which the bag was subjected.

e. In case failures occur other than those covered by the questions above, what are the contributory conditions and causes?

Only a small quantity of these bags were used and no failures occurred.

Note. It was generally agreed by the entire group that the bag, clothing, was essential for carrying extra clothing and equipment by plane crews when engaged in over water operations.

4. Glasses, Sun, M-1944.

a. Will item withstand normal blows at low temperatures, like dropping on a hard surface, or knocking glasses off on a door, etc.?

No failure of lens occurred because of low temperatures; however, there were several instances of the lens cracking.

b. How is shadow contrast on a bright snow terrain? A dull snow terrain?

The Air Corps F-1 sunglasses proved superior to the glasses, sun, M-1944 for shadow penetration and minimum color distortion.

c. Are sunglasses sufficient protection from the cold at low temperatures, and can they be used if face masks of some kind are worn?

No attempts were made to wear the sunglasses with a face mask. For the most part face masks were not required.

d. What relative preference between this item, goggles, M-1944, and other types of glasses used?

The glasses, sun, M-1944 were preferred to the goggles, M-1944, because of the lighter weight and less bulk; however, the glasses, sun F-1 (Air Corps) were preferred to both types because of clearer vision, greater penetration of shadows, and minimum color distortion.

e. Other pertinent observations on glasses, sun, M-1944:

(1) No snow-blindness occurred during the operation. This was due principally to the dark glass discipline that was followed by the members of the Task Force and to extended orientation aboard the ship en route to the Antarctic.

(2) Directions for properly cleaning the sunglasses were seldom followed. The individual would clean the glasses using materials at hand.

(3) Scratching of the lens was prevalent, but it did not impair the vision of the wearer.

5. Lipstick, Antichap, Cold Climate.

a. Does it adequately protect lips against chapping?

The antichap lipstick proved adequate for protection of the lips against chapping.

b. Does it heal lips which are chapped?

The lipstick preparation was very good in relieving painfully chapped lips. It was also used to relieve pain caused by hangnails.

c. Is it equally effective on other exposed skin of hands and face?

Yes.

d. Any comments regarding difficulty in pushing stock out of dispenser tube?

Some difficulty was experienced in pushing the stock out of the container, but this was overcome by using a pencil or some other small object. It is suggested that the container be made larger in diameter so that the stock can be pushed out with the finger.

e. Is the consistency of lipstick satisfactory at temperatures encountered?

The consistency of the lipstick was satisfactory for the temperatures encountered.

6. Matches, Ordinary, Water-Resistant.

a. What is color of match head?

Matches used had green colored heads.

b. Did matches fail to ignite because of dampness?

Several immersion tests were conducted to determine the adequacy of these matches and in all cases the matches proved adequate. In one instance matches carried in the parka pocket were covered with snow but they functioned satisfactorily upon striking.

c. Any difficulty in striking matches due to breaking of match stick?

There were some cases of match sticks breaking upon striking, but it was agreed that the matches are satisfactory.

d. Are matches any more or less wind-resistant than ordinary book matches or wood safety matches?

No observations were made on this point.

7. Containers, Food, Insulated.

The containers received little use for their intended purpose of transferring hot food from one location to another. The individ-

ual containers contained in this unit were used as individual pots by different groups within their tents. In cases where the containers were used for transporting hot liquids such as coffee, some heat loss occurred during the time the coffee was dispensed.

8. Ropes (Climbing—Nylon and Manila).

The ropes of this type were used primarily as standard emergency aircraft equipment, particularly the nylon climbing rope. As this material was kept inviolate for any other use, it was not made available for general use around the camp to get any observations. As handled it seemed to be standing up perfectly normally.

9. Outfit, Cooking, One-Burner.

This item was used as standard aircraft emergency equipment. There were just enough of them available for that purpose. They were kept in the planes and were not permitted to be used otherwise. One problem, of a rather serious nature, regarding these stoves is the carrying of extra gasoline. The cans selected by the expedition originally were 5-gallon type, which were too weak to stand up and were substituted for containers, gasoline, 5-gallon. There was a great deal of resistance on the part of plane crews to carry white gasoline when they knew their aircraft would probably have many gallons of 100-octane gas in it. The question is raised regarding the use of 100-octane leaded gasoline in these stoves and the length of time the stove can be operated with this fuel.

10. Shoepacs, 12-Inch, M-1944.

a. *General.* The shoepacs were available to all members of the expedition. A great many persons wore them on the ice. It is believed that, in general, when they were worn in temperatures of at least 15° above zero and in many cases down to zero or a

little below, the shoepac when properly worn with the proper equipment inside was satisfactory.

b. Socks and Insoles Worn Inside the Shoepac. It was observed that in many cases there was not adequate briefing given to the men when the shoepac was issued by the regular issuing personnel and as a consequence there was a great variation in sock combinations. In one instance an individual complained of cold feet. Upon questioning he claimed that he had used every combination he could think of, and after reviewing them it was discovered that he had used every combination except the authorized one.

c. Sock Sizes. There was little briefing given and in many cases instead of using larger sizes over the smaller ones, some of the men tried to use the same sized socks. They also used Navy socks as substitutes for the regular ski socks.

For the most part the shoepacs were used on the névé surface of the Ross Shelf ice and worn in a typical barracks type condition in and out of the tents, where they would be covered by snow part of the time.

d. Did the shoepac support the feet properly?

There is no adverse criticism in regard to this.

e. Describe any resulting foot ailments and state probable causes.

There were no foot ailments that could be attributed to wearing the shoepac.

f. Describe any breaks in the rubber portion of the shoepac.

It was noted on two occasions that the shoepac broke down on the toe crease. The rubber separated from its fabric base. This happened twice during temperatures down to about -10° F.

11. Boots, Ski, Mountain, with Rubber Cleated Soles.

a. General. These boots were issued primarily for skiing purposes; however, there

were more boots available in general than skis, as the skis were delayed in arriving or kept as emergency gear in aircraft. Many individuals wore ski boots a large part of the time, as the warmth of these boots is comparable to that of the shoepac when wearing the proper sock combination. The individuals who wore the ski boots for the first time as well as the shoepacs felt that their feet were warmer in the ski boots.

Temperature at time of operation ranged from slightly above freezing to 25° below zero. The percentage of relative humidity at the time of test was extremely high; however, the absolute humidity was low.

Environment at the time of the test for the most part was on névé or compacted snow, and on sea ice. A limited number of tests were made on bare rocks. The boots were worn in tents with wooden floors and on ships. In all cases the traction was adequate.

b. Would the boots be more comfortable if lighter in weight?

It was generally agreed that a lighter boot would be desirable. There was some complaint regarding the weight of the boots; however, when used as ski boots with the skis attached, the feeling of weight is reduced.

c. Is the boot comfortable?

The boots were very comfortable and were preferred to the shoepac by many members of the task force.

d. Does the boot cause foot fatigue when worn only a short time?

There is no evidence of the boots causing any more fatigue than other types of footgear.

e. Is the ski boot generally satisfactory for skiing and mountain and rock climbing?

Yes.

f. Does the leather remain flexible in cold temperatures?

The leather remained flexible down to approximately 0° F.

g. Are the boots waterproof?

The expedition was not troubled very

much with conditions where there was any free water; consequently, the boots were adequate for the waterproofness.

h. Is the attachment of the rubber-cleated sole to the midsole satisfactory?

There were no cases of the soles on the boots tearing loose.

i. Where do the boots fail?

To the best knowledge of the group of observers, there were no failures.

12. Bag, Duffel.

a. Is this item of suitable size and dimensions for shipboard requirement?

The size of the bag is dependent upon the amount of gear the individual is required to carry. However, it is about the largest size that a man will want to carry; therefore, it is approximately correct.

b. Are the handles and shoulder strap assemblies suitable?

Those who drew Navy sea bags without the straps automatically looked for a strap or handle to grab hold of. The handle and shoulder strap on the duffel bag are suitable and very desirable.

c. Is the closure preferred to that of the sea bag?

The closure is quite satisfactory and definitely preferred to the closure of the Navy sea bag.

A general résumé of the group of observers indicates the bag is an excellent item as it stands with a few exceptions.

13. Suspenders, Trousers.

Are suspenders preferable to waist belts?

The problem of suspenders versus waist belts is largely dependent upon whether or not suspenders can be reached with ease when one has to attend to natural functions. Although a number of men wore suspenders, the majority of men preferred the waist belt because of the convenience of being able to get to the belt quickly.

14. Tent, Mountain, Two-Man.

Because of the limited number of these tents made available to the task force, only general comments can be made regarding the functionality of the tent. The now standard tent, mountain, treated with plastic sizing for waterproofness, stiffened considerably in temperatures slightly below freezing. The experimental mountain tent made specifically for the expedition was used primarily as emergency equipment in the planes and received little use. However, one of these tents was erected for inspection and it was considered to be a great improvement over the standard item. While erected this tent was subjected, accidentally, to the full blast of an airplane's propellers with the blast of air estimated to be 100 m. p. h. striking the tent. Even though one of the poles was broken and several of the tent pins pulled out of the snow, the tent withstood this blast without any severe damage.

15. Tents, Lightweight, Pyramidal.

These tents were used as emergency equipment on the aircraft and were not available for use or inspection by other personnel. Because of this there are no comments regarding the adequacy of this tent.

16. Tentage and Paulins.

a. During operations on the Ross Shelf ice the force was housed in pyramidal tents, 20 by 16 feet. Wooden flooring was available for all tents and a framework was constructed to hold each tent. In addition to the pyramidal tents, two hospital tents were used. No unusual problems were encountered in erecting any of the tents. The tents offered little protection from winds since wind would enter through the laced corners, the top of the tent, and through the door. In most cases snow walls were constructed or liners were improvised to stop winds from blowing in the tents.

b. Frosting and icing occurred in the tents, and during periods of high winds the heat loss of the tents was increased and noticeable.

c. The tent poles and other accessories of the tent were considered adequate. It was noted that the wooden center pole, because of its proximity to the stovepipe, was frequently scorched, but the hazard of having the pole burn up was overcome by covering the area near the stove with asbestos.

d. Occupants of nearly every tent made many alterations, the two most common were auxillary entrances and plastic windows.

e. Tents that are intended for use during the polar light season should have windows for light and observation, and for the sleeping comfort of the men, black-out facilities should be provided.

17. Clothing, General.

There were so many types of clothing issued that there was not a great deal of uniformity in the use of clothing, and few, if any, complete Army assemblies were ever used at any one time by any individual in order that true observations could be made of the Army's clothing as it was intended. Part of this was due, at the start, to issuing windproofs which were felt to be of better design in many respects than the general Army windproofs. They were of a design primarily taken from an Antarctic type, made of the Army's tackle twill and manufactured by the Navy. These were used by many individuals; they were the outside item and covered up the inner one so that it was difficult to spot insulating items of Army clothing.

18. Gloves, Shell, Leather, and Gloves, Wool, Insert; Mittens, Shell, Trigger Finger, and Wool Inserts.

a. Are these assemblies warm enough for temperatures encountered?

As for the gloves, shell, leather, and gloves, wool, OD, the temperatures are too low for continued use of these gloves in general below freezing temperatures, and in below zero temperatures they are absolutely inadequate. The mittens, shell, trigger finger, were warm, in general, down to temperatures as low as they went, though had the Arctic mittens been available, they would have been worn by many of the people on the coldest days.

b. Which assembly was preferred for warmth, dexterity, and comfort?

The mittens, shell, trigger finger with wool insert were definitely preferred to the glove combination for warmth. A few photographers requiring a high degree of dexterity wore the gloves.

c. Is any appreciable amount of difficulty noticed caused by the slipperiness of the cloth trigger finger?

A considerable amount of difficulty was caused by the slipperiness of the cloth trigger finger.

d. Is the trigger finger of correct length and width to allow the best manipulation of the finger?

Since the group was not armed with weapons there was little use of the trigger finger.

e. Is the dexterity of the trigger finger satisfactory to the majority of tasks?

The majority of the tasks in the Antarctic should be for the complete use of the hand; in other words, the best philosophy for designing equipment for polar work should be that it can be manipulated with mittens without taking them off. It is not, therefore, considered desirable to try to make the fingers do the work but to change the equipment whenever possible so that one can do it with mittens. You can't change the man to fit the equipment; the equipment has to be built to fit the man.

f. Is the gauntlet easy to adjust when putting on mittens?

It requires a certain amount of accustomization. After learned, they can be put on reasonably well.

g. In general, what part of the hand gets cold first?

The fingers. The palm of the hand is not nearly so sensitive. It is usually the tip of the index finger or the thumb that is noticeable first.

h. Is the fit of the mittens satisfactory?

The Army mittens' fit was relatively satisfactory when used with the Army's insert, but when the Navy's insert was used it was not a satisfactory fit. (The Navy's wool insert was too tight and continuously isolated the index finger from the other three.)

19. Socks, Wool, Cushion Sole.

a. Due to the unavailability of sizes when socks were issued, the sock combination consisted of both Army and Navy socks. Because of this, no comments on the adequacy of this combination will be attempted.

b. Those individuals that received the socks, wool, cushion sole, were notably impressed with the comfort this sock afforded.

20. Jacket, Field, M-1943; Jacket, Field, Pile, OD.

Because of the preponderance of the personnel who wore the Navy outer parka and trouser combination, not a great many of the jackets, field, M-1943, were worn. In view of this only limited information is available on these two items. The few people who did wear these jackets were favorably impressed with the insulation value of the combination and agreed that it pro-

vided adequate comfort for the temperatures encountered. It was observed that the detachable hood on the jacket, field, M-1943, was not adequate in sub-zero temperatures and that wind-blown snow would enter the hood at the back of the neck.

21. Shirts, Wool, Flannel, OD.

A résumé of the comments offered on this item by the Army observers indicates that the shirt was well liked by all personnel.

22. Overcoat, Parka Type, with Detachable Pile Lining.

This item was not issued to personnel operating on the ice barrier. The Navy parka type overcoat of similar design was issued to some personnel. It is generally considered that this item might be good for barracks wear such as leaving the tent and going over to the mess hall instead of the inconvenience of throwing on parkas over the head, but for general work purposes it is not considered a particularly good item.

23. Trousers, Field, Wool Serge, 18-Ounce Special.

The entire observer group agrees that this trouser is satisfactory. They were worn by nearly all personnel as the item over the wool underwear. There are no particular constructive suggestions or criticisms regarding the trousers.

24. Cap, Field, Cotton, OD, with Visor.

The cap, when properly fitted, proved satisfactory for the temperatures encountered on the operation.

OPERATIONAL AND PLANNING DISCUSSION

1. Hijump Operational Techniques.

a. Each expedition of the past which has gone into the Antarctic regions has used new and improved techniques better to attack the problems of the unknown. This advancement has been very rapid since the beginning of this century. Not always are the techniques better than the past and often an expedition fails to learn all the lessons it should from the past with a consequence that much independent rediscoveries are made both geographically and technique-wise.

b. This appendix is not intended as a criticism of Operation Highjump but primarily as an analysis of the relative advance of this expedition over those of the past. From it may be seen the major contributions and the avenues for future improvement.

c. By and large the Navy used new techniques which can be considered of great improvement. It was by far the largest, swiftest, and most elaborate expedition to date. The major contributions to exploring technique are listed briefly:

- (1) Mass attack with multiple operating bases.
- (2) Increase of manpower available by about 20 times any previous Antarctic expedition.
- (3) The use of ice breakers about 10 times as powerful as any used in the past.
- (4) The use of several types of aircraft more advanced than those available in the past.
- (5) The use of the airborne magnetometer.
- (6) The use of naval logistics as a basis.
- (7) Improved standards of living conditions with more reasonable working hours.

(8) The availability of a network of meteorological stations.

(9) The facilities of the naval communication system.

(10) Widespread public relations (12 or more news correspondents and radio broadcast representatives).

(11) Maximum utility of the summer working season.

(12) Superlative photographic coverage (60 in photographic staff).

(13) Naval discipline and health facilities.

d. A few of the above advances in techniques require further discussion and some of their limitations will be commented upon.

2. Organization and Preparation.

a. No past expedition even of much smaller size was ever outfitted so swiftly. Most past expeditions have been privately organized and required from 1 to 2 years' preparation time. Task Force 68 was operating in the Arctic from July to October 1946 and little advanced planning was possible until it returned. This meant that the whole preparation had to be achieved between October and December. The bulk was achieved during the single month of November. Only by the complete facilities and cooperation of the Navy Department and assistance by the War Department was the feat accomplished. The expedition was staged in several ports simultaneously. Shipments were expedited by rail and air from all parts of the country. The primary difficulty with this procedure lay in the fact that no one supply officer could be personally aware of the receipt of

the shipments. Everything was on paper. Contents of all boxes could not be checked, adequately marked, or stowed in the most desirable sequence for unloading.

b. The color and identification system, the inspection, repacking, and loading used, for example, by the United States Antarctic Service Expedition in 1939 made it possible to know for certain exactly where any item was at a given moment and the quality and quantity of the contents were always assured. Each box was identifiable at a distance by color markings, large letters, and a specific number as to what department it belonged to and what it contained. The confusion of markings on the Navy's packing cases often defied close examination as to whom it belonged or what its contents were.

3. Recommendations.

On a polar operation the Army should avoid unnecessary rushing of logistic and other planning where elements of the operation procedures are not clearly known. Time should be taken to make certain that all possible advantage is taken of past experience to avoid classical mistakes. Where field parties are expected to be self-sufficient all equipment should be checked by the supply officer to make certain that items are properly packed and that they are of the required quality, quantity, and size. Finally, a simple but effective marking system should be employed that will permit quick location of items. Contrasting colors used to stencil on bold letters 6 to 12 inches high should be prominently placed on all sides of each packing case. A box number in figures 2 to 6 inches high should also be placed on all sides. The advantages of such a procedure are that, where cargo requires several stages of handling, boxes of similar color markings or letters can easily be identified and segregated. A stray box can be spotted out of place by even inexperienced hands and the

series numbers gives a quick check for location of specific boxes. By having markings on all sides, boxes can be spotted quickly without unnecessary handling and frequently in areas of drifting snow boxes become partly drifted in so that searching becomes labor of digging beyond the wildest nightmare of a warehouse man. All caches laid down should be segregated, well stacked, and carefully marked with tall poles. In one "blizzard" it is possible to lose parts of badly stacked caches and individual boxes which are segregated by even a few feet. Drift snow will pack into all crates and badly closed boxes. Under periodic melting conditions materials may become damaged or at least iced up.

4. Ice Navigational Instruments.

a. The U. S. S. *Northwind* was a revelation to all the Antarctic veterans who saw her breaking into the ice pack. Areas and conditions previously thought to be unnavigable were easily penetrated. Her 12,000 horsepower found her still making a sizable impression in midsummer ice 18 to 20 feet thick in a bay where there was no opportunity for lateral displacement.

b. Many areas considered inapproachable along Antarctic coasts could now be penetrated. New base sites could be located. The *Northwind* and *Burton Island* are two of the best polar exploratory tools owned by the United States and should be used to investigate coastal areas of the Antarctic whenever they are not required for more useful investigation in the Arctic.

c. The potentiality of the Navy's ice breakers should be watched with keen interest by the Army for their ability may make available new tactics and base locations in the Arctic. These ice breakers are much newer experimentation for ourselves than for the U. S. S. R. for whom the first sister ships of the *Northwind* were constructed. It

is considered possible to construct ships even more powerful which might open the Arctic Ocean for future transshipping of cargo between Eurasia and North America. Such shipping might not necessarily be confined to the summer season only. Although it can be expected that air transport over the Arctic will be a major means of travel it should not be overlooked that we have not yet by any means exhausted our possibilities of over water, under water, and over pack ice means of transport. The truth is we have not yet tried very hard to exploit those possibilities. The new ice breakers were built to do a job in pack ice and they do it. The Army has not yet tried to build a surface vehicle which could travel over pack ice. It can't be an item modified from an existing tropical or temperate climate design; it will have to be an item built specifically to cope with the physical characteristics of polar and pack-ice conditions.

5. Personnel.

a. The Highjump operation was a test of routine equipment and personnel. This was of great operational significance and showed several contrasts with former expeditions. Men who volunteer and have ability to do their job are usually happy on Antarctic expeditions. They are there because they want to be, and the *esprit de corps* is high. They know what the job is and tackle it without complaint or with an eye on the clock. The *esprit de corps* would have been higher and the quality and quantity of work would probably have been greater on Operation Highjump had all the men wanted to be there and known why they were carrying out the operation. As far as the ice party was concerned the best example of teamwork and efficiency was probably the galley and mess force which prepared four meals a day around the clock and always on time. Their working conditions were difficult but

their spirit was good. They had a clear-cut job to do and they did it. In other cases efficiency and spirit were largely dependent on the quality of leadership and a few outstanding men. The men who knew clearly their responsibilities were the natural leaders. There can be no real criticism of the men who did their best. Had they been hand-picked they might have done much more.

b. Veterans quickly become obnoxious when they are in the minority. They speak boldly of conditions to be met and frequently in a changeable place like the Antarctic the unexpected usually happens. A veteran of more than one previous experience generally becomes more cautious for he realizes the times he has been wrong and may be embarrassed by the braggadocio of one-time veterans. In short, new men resent being told what to expect and quickly lose faith when the predictions prove wrong or are interpreted wrongly. Soon there builds up a disregard for the veterans and they may become almost ostracized. Neglect of warnings are sometimes unfortunate in consequence and even the innocent veteran is identified with false predictions which he did not make. But he is branded because he is a veteran. Veterans are important on an expedition as a link with the past as long as they are not tied to it. Extreme tolerance is required on both sides to prevent misunderstandings. The veteran is prone to step outside his field of personal knowledge and may make unusual circumstances of the past seem like the usual or common experience. Each man who goes on an expedition becomes a veteran and if he goes twice he may find his whole outlook changed and soon has to realize that he didn't learn everything the first time. An expedition which fails, on the other hand, to heed some of the advice of its veterans has strong critics close at hand, a circumstance frequently justifiable. This comment is in-

cluded here in place of a series of criticism of minor nature which would show how certain knowledge of the past had to be learned the hard way. On the other hand, an equally long list could be made in rebuttal of how new ingenuity and different circumstances were improved in the face of veteran predictions.

c. It behooves the Army to make careful study of any polar operations which it carries on in the future to try and *make use of veteran knowledge* without being held back by predictions of impossibility. Each new experience will be different and only a portion of past experience will apply.

d. Only a few broad observations could be made of new unpredictable problems encountered by the massive naval attack on the Antarctic. These are offered not in criticism of the Navy but as a warning to the Army if it should try to carry out a similar operation.

6. Base Communications and Transportation.

The larger a base camp the more difficult will be communications and transportation. The Navy's base camp was spread out in excess of a half mile square. The lack of local field phone communications and availability of transportation made search for an individual on foot very difficult. One would walk on skis laboriously across the width of the camp only to find the man he wanted had just gone back to the other side. Such circumstances slowed down progress to a large extent. The solution would be either a net of field telephones or adequate fast transportation.

7. Scientific Observations and Discussion.

a. This expedition was a naval operation in which scientific observation was secondary. This was made clearly understood. However, the public relations approved by the Navy led the public to believe that it was

a scientific enterprise fostered by the Navy. This was unfortunate in some respects, for it placed the expedition scientists in an awkward position. They had little support often in the field and had to explain why they didn't do more by the agencies who sent them.

b. An operation into a little known area cannot fail to be expected to return with new knowledge. There should be a more clear-cut relationship between operations and scientific work. The Navy showed great wisdom in giving a mapping, testing, and scientific project to an operating task force. It gave a morale incentive that the operation was worth while. It is questionable that as much would have been achieved by Task Force 68 had it not had the interesting and publicized project Highjump. When the ice became a hazard the ships could have pulled out had they not been faced with failure of the scientific part of their mission, which was vitally important to the public.

c. Operation Highjump can be measured in three ways: what it did; what the public believes it did; and what it could have done. The first two are a matter of record, and in respect to lesser expeditions of the past the achievements are the greatest yet. It is only when we examine what it could have done that we see chances of improvement for the future. In view of the fact that a review of these points could only be regarded as criticism which would detract from the excellent achievement by the Navy, the specific points are better left unlisted, for they are well understood or can be deduced by those concerned with map-making, radar, radiation studies, glaciology, navigation, geology, terrestrial magnetism, and other fields of science.

d. The pertinent conclusion is that during opportunities for observations operations should serve, not direct, a research program.

A project director or scientific director should coordinate research work and have the facilities of the operation staff to assist in carrying the work out. In Navy and Army channels an operations officer is considered always senior. His understanding of research requirements may be as far removed as ship operations would be to a geologist.

e. It is broadly recognized that the scientist has and must still have a more important role in the Armed Forces. Task Force 68 served to emphasize the distance we must go before the scientist and the military can work

on an even footing. If the Army should attempt to carry out a similar scientific Task Force it is recommended that the attitude be taken that an appointed Scientific Director be responsible to coordinate and plan the field research and that operations be charged with the responsibility of carrying them out safely and successfully. The scientist needs the support of operations. It is folly to assume that operations can do the research planning by itself unless the operations officer is a qualified scientist himself—a most rare combination.

GLACIOLOGICAL STUDY OF BAY OF WHALES AREA

The history and formation of the Bay of Whales has been of scientific interest since its discovery over a century ago by Sir James Clark Ross. Why is the bay persistent in its location and still constantly changing its appearance? The true nature of the bay could hardly be determined in a single visit, for the bay structure occupies an area close to 800 square miles and the changes in shape are slow. It was not until after the Byrd Antarctic Expeditions had occupied the area three times at intervals of about 5 years apart that the story began to unfold itself. Mapping and aerial photography was done on each trip and the relative direction of movements was established. The determination of the direction and rate of movement of the sites of Little America I and II gave the first clue.

There will be no attempt in this paper to give a whole discussion of the Bay of Whales, but those new facts and measurements made during Operation Highjump will be listed for record. A general background of facts will suffice to set the scene for these new observations.

Essentially the Bay of Whales owes its existence to the presence of Roosevelt Island to the south, around which flows two great shelf ice systems. Roosevelt Island is completely snow covered, rising to a maximum elevation of about 1,200 feet. The island is over 50 miles long and averages about 10 miles across. Its exact size and shape can as yet only be estimated because of its snow cover; however, its reality has been proven by seismic soundings and on Highjump expe-

dition by the airborne magnetometer. To the westward flows the central portion of the Ross Shelf ice. This shelf is part of a sheet of ice only occasionally deformed, measuring roughly 300 miles east to west and 400 miles north to south. (The far western portion of this shelf may later be proven to be an entity in itself.) Along the eastern side of Roosevelt Island flows another shelf ice approximately 100 by 200 miles in area. This sheet has always been considered part of the Ross Shelf ice; however, it is both separated and of different origin. The name Borchgrevinck has been proposed for this portion of shelf to honor the first man to set foot on the shelf ice at the Bay of Whales in 1900.

The Bay of Whales is the deformed area caused by the conflict of these two shelf ice systems as they clear the north end of Roosevelt Island and approach one another. The western shelf (Central Ross Shelf) is moving irresistably northward about one quarter of a mile a year into the Ross Sea. The Borchgrevinck Shelf, on which all of the bases in the Bay of Whales area have been established, is not moving directly northward toward the apparent path of least resistance, but has apparently struck a submerged obstruction and the primary forward motion is westward. This means that the navigable portion of the Bay of Whales is constantly closing. As the two shelves meet, great pressure and splitting of the shelves occur and the seasonal bay ice is churned and collapsed into a tangle of ice which thickens to shelf ice proportions.

On the basis of previous studies, the writer had a basis to predict that the navigable portion of the Bay of Whales would be closed in late 1946. This would have, of course, prevented the use of the Bay for the Central Group of Task Force 68. The prediction carried with it several unpredictable conditions, which were—

1. The Bay would be closed or so jammed with ice that ships could not enter,

2. Or that the meeting of the shelves would be slowed down by ice jammed in the jaws,

3. Or that the great force would cause a breaking off of large masses of shelf ice that would cause an improved and enlarged bay,

4. Or that the fragile end of West Cape which protruded out as a long arm would break off and leave a small but partly usable bay for the next 4 or 5 years.

The mouth of the Bay of Whales was about 10 miles wide in 1911 when Amundsen wintered in the Bay. The entrance was much farther south and he was able to sail the *Fram* up to the shoals off Roosevelt Island. In 1929 the first Byrd Expedition found the bay mouth 5 miles wide; in 1934 it had narrowed perceptibly; and in 1940 it was only about 1½ miles wide.

The arrival of the Central Group at the Bay of Whales in mid-January 1947 was a greatly anticipated event for the writer.¹ The mouth of the Bay was not closed even though it was less than 1,000 feet wide. The *Northwind* found the bay ice intact but fearlessly entered and broke out a lagoon about 2 square miles of sufficient size to let the cargo ships enter within 24 to 48 hours. It was not until the writer had an opportunity, 2 or 3 days later, to fly over the bay in the helicopter observation plane that he could determine just what had happened. The bay mouth had closed a little ahead of anticipated schedule. About one-half mile of the tip of West Cape had broken off and

a small dent had been broken out of the barrier wall of the contact point against the Borchgrevinck Shelf.

While in the Bay of Whales during January and February 1947, the writer set up measuring points to determine the rate of flow of the shelves. Along one tension crack near the east side of the bay two check measurements were run until the deforming ice destroyed the markers. The rate was extremely uniform and was found to be 4.37 feet per day for the Borchgrevinck Shelf moving westward. Two sets of large markers were placed on the shelf ice at either side of the narrow entrance. These were photographed periodically from the air, and measurements were taken by alinement. The markers were originally all in a straight line and the pairs on each side were placed accurately 300 feet apart. The displacement showed that the western shelf was moving northward at a rate of 4.4 feet per day. The surprisingly close agreement in the rate of movement of these independent shelves was still more amazing when it was checked against a previously measured movement of the Ross Shelf near McMurdo Sound. Here, too, the rate was approximately 4.4 feet per day. Whether these closely agreeing rates are just coincidental cannot yet be ascertained; however, it suggests that the character of ice thickness, snow accumulation, and climatic conditions are sufficiently uniform to give flat lying shelf a constant rate of flow no matter what its direction might be.

The bay mouth closed about 170 feet while we were in the bay. The remaining distance to complete a second closure was calculated to be covered during the middle of the winter season in June or July 1947. From appearances the West Cape would again break, perhaps to an even greater extent. Within 4 or 5 years the navigable portion of the bay will be completely compressed and by that time a great cataclysm

¹ Dr. Paul A. Siple.

will be close at hand which will cause much larger portions to be broken out under these irresistible forces' meeting. The west side may continue to break for years to come, for it appears to be the more easily dislodged, but the east side will have to give also. The cycle of the Bay of Whales cannot be determined with certainty as yet but is probably about 50 years. When the great cataclysm occurs, the sites of Little America I, II, and III, as well as the more precarious tent camp of Operation Highjump will float out to sea. This sentimental loss will be made up for, however, by the realization that a new, enlarged Bay of Whales will be available, as a much better harbor than it is today, for the next 20 or 30 years.

Additional work was done on the general study of the Bay of Whales area. Numerous areas were checked visually by the writer and Mr. Davis from the OY plane, piloted by the latter. The entire 800 square miles were studied carefully from all directions. The direction of all stress lines, tension cracks, and pressure ridges were checked carefully and found to fit all of the surmised conditions.

Trimetrogon photographs were taken of the central bay area as the fourth of a series of aerial studies since 1929. The front of the shelf ice or barrier wall was mapped again for gross study of the whole shelf ice front. A base line was laid and tied into the survey line of 1940 to check the absolute movement of the Little America sites.

Special studies of the ice structure were made by Arthur Howard, the geologist. These physical measurements should give a better understanding of the gross deformation.

The survey made in the area by the airborne magnetometer by Mr. Balsley located independently a rise in the ocean floor that ties the Borchgrevinck Shelf near Kainan Bay. The writer flew over this area many times in 1940 and 1947 to try to locate the specific area. He noted certain tension cracks which indicated the probable tied spot was on the east side of Kainan Bay and you can imagine his gratification when, quite by accident, Mr. Balsley announced the confirmation.

The study of the Bay of Whales area has been taken up by the National Research Council under a committee entitled "Deformation of the Ross Shelf Ice" under the chairmanship of Dr. Walter Bucher. A number of structural geologists and glaciologists have been interested in the study. A grant for research work was made by the Geological Society of America. The primary reason for the interest in this area is that by better understanding the structure of the homogeneous ice deformation in the Bay of Whales a better understanding may be had of the crustal deformation of the earth's surface. Here in miniature is a reproduction of most of the earth's crustal type of disturbances due to tension and pressure.

MECHANICAL CHARACTERISTICS OF NÉVÉ SNOW SURFACES

The Army observers considered that one of their primary responsibilities while at the Bay of Whales was to collect engineering data regarding the mechanical characteristics of névé snow surfaces. A large portion of this collection of data was made in conjunction with Navy base engineering studies, most of which are discussed in the Navy's official report and under chapter 3 of this volume. The following pages include a few additional observations made independently by Army personnel not reported elsewhere.

The question of snow accumulation has long been a matter of question in the polar regions. Normal meteorological methods for recording snowfall have proved unreliable because of drifting snow. On the United States Antarctic Service expedition, 1940-41, Dr. F. A. Wade and his associates carried out a project to determine snow accumulation rate for 1 year in the vicinity of Little America III.¹ In 1940 several aerial mapping markers were placed on the face of the snow for ground control. These consisted of canvas strips laid on the surface in the form of a large cross and marked with a bamboo pole in the center. Upon the return to this area in January 1947 some of these markers were still visible and determinations of accumulation over a 6-year period of a distance of more than a mile from any surface structures were possible.

One of the canvas strips was laid within approximately 20 feet of the eastern edge of

the Bay of Whales directly west of Little America III. The canvas strips, after 6 years, were still essentially on the surface. This would indicate that the barrier edge does not build up, but probably erodes under a constant flow of wind, which explains primarily the commonly observed fact that the forward edge of the shelf, or barrier as it is best known, is lower than the surface behind it. Generally there is a difference of 25 to 50 feet. The reason snow does not accumulate at this point is obviously due to the sweeping effect of the wind and the tendency for the colder air on the shelf surface to flow over the edge due to Katabotic forces. This flow of air causes an increase of wind velocity approaching the very edge and gives rise to the drifted ice foot below and the picturesque cornices and snowfall figures along barrier edges.

At a distance of approximately 3,000 feet back from this edge the barrier surface had reached its characteristic level. At this point an old marker was still observable. Two inches of one of the bamboo poles still projected above the surface. At Dr. Siple's suggestion Captain Wiener dug down to the canvas strips below and found the total accumulation over the 6-year period to be 97 inches. This could not, of course, be apportioned equally for each year because of the tendency toward compaction. Twenty-seven samples were taken to determine the approximate density of the cross section at all levels. The following table shows these observations:

¹ "Proceedings of the American Philosophical Society," page 168, volume 89, Number I, April 30, 1945.

Computation Sheet

Determination of In-Place Density of Snow

Ross Sea Ice Shelf, Bay of Whales, Antarctica

Date Observation: Feb. 22, 1947. Temperature: 11° F. Observers: Reinhardt, Holcombe.

Sample Point: At old survey monument established 1941.

Depth below surface (in.)	Thickness (in.)	Average cross section area (sq. in.)	Volume (cu. in.)	Weight (lbs.)	Density (lbs. per cu. in.)	Specific gravity	Dimensions of cross section (in.)
0-23 ³ / ₈	2.375	59.766	141.944	1.72	0.0121	0.3352	6 ³ / ₈ x 9 ³ / ₈
23 ³ / ₈ -5 ³ / ₄	3.375	58.594	197.755	2.72	0.0138	0.3823	6 ¹ / ₄ x 9 ³ / ₈
5 ³ / ₄ -8 ¹ / ₈	2.375	57.813	137.306	1.85	0.0135	0.3740	6 ¹ / ₄ x 9 ¹ / ₄
8 ¹ / ₈ -11 ¹ / ₂	3.375	55.891	188.632	2.86	0.0152	0.4211	6 ¹ / ₈ x 9 ¹ / ₈
11 ¹ / ₂ -14 ³ / ₈	2.875	54.750	157.406	2.40	0.0152	0.4211	6 x 9 ¹ / ₈
14 ³ / ₈ -15.....	No specimen.						
15-19 ⁵ / ₈	4.625	68.141	315.152	4.70	0.0149	0.4127	6 ¹ / ₈ x 11 ¹ / ₈
19 ⁵ / ₈ -21.....	No specimen.						
21-24 ⁷ / ₈	3.875	65.000	215.875	3.48	0.0161	0.4460	6 ¹ / ₂ x 10
24 ⁷ / ₈ -27 ⁵ / ₈	2.750	65.000	178.750	2.36	0.0132	0.3657	6 ¹ / ₂ x 10
27 ⁵ / ₈ -32.....	4.375	65.000	284.375	4.26	0.0150	0.4155	6 ¹ / ₂ x 10
32-35 ³ / ₄	3.750	61.875	232.031	3.29	0.0142	0.3934	6 ⁷ / ₈ x 9
35 ³ / ₄ -38 ⁷ / ₈	3.125	59.063	184.572	2.50	0.0135	0.3740	6 ³ / ₄ x 8 ³ / ₄
38 ⁷ / ₈ -40 ³ / ₄	1.875	56.531	105.996	1.95	0.0184	0.5097	6 ³ / ₄ x 8 ³ / ₈
40 ³ / ₄ -45 ¹ / ₄	4.500	53.828	242.226	3.26	0.0135	0.3740	6 ⁵ / ₈ x 8 ¹ / ₈
45 ¹ / ₄ -51.....	5.750	51.344	295.228	4.67	0.0158	0.4377	6 ⁵ / ₈ x 7 ³ / ₄
51-54 ¹ / ₄	3.250	66.656	216.632	3.07	0.0142	0.3934	6 ³ / ₄ x 9 ⁷ / ₈
54 ¹ / ₄ -56 ⁷ / ₈	2.625	64.594	169.559	2.65	0.0156	0.4321	6 ⁵ / ₈ x 9 ³ / ₄
56 ⁷ / ₈ -60 ¹ / ₈	3.250	63.375	205.969	3.28	0.0159	0.4404	6 ¹ / ₂ x 9 ³ / ₄
60 ¹ / ₈ -64 ⁵ / ₈	4.500	64.186	288.837	3.93	0.0136	0.3767	6 ¹ / ₂ x 9 ⁵ / ₈
64 ⁵ / ₈ -67 ³ / ₄	3.125	61.359	191.747	3.16	0.0165	0.4571	6 ³ / ₈ x 9 ⁵ / ₈
67 ³ / ₄ -72 ⁷ / ₈	5.125	88.375	452.922	5.80	0.0128	0.3546	12 ⁵ / ₈ x 7
72 ⁷ / ₈ -76 ⁷ / ₈	4.000	86.625	346.500	4.76	0.0137	0.3795	12 ³ / ₈ x 7
76 ⁷ / ₈ -80 ³ / ₄	3.875	87.281	338.214	4.47	0.0132	0.3656	12 ¹ / ₄ x 7 ¹ / ₈
80 ³ / ₄ -84 ⁵ / ₈	3.875	86.391	334.765	4.32	0.0129	0.3573	12 ¹ / ₈ x 7 ¹ / ₈
84 ⁵ / ₈ -88 ³ / ₈	3.750	87.000	326.250	4.03	0.0124	0.3435	12 x 7 ¹ / ₄
88 ³ / ₈ -92 ¹ / ₈	3.750	51.188	191.955	2.84	0.0148	0.4100	5 ¹ / ₄ x 9 ³ / ₄
92 ¹ / ₈ -94 ⁷ / ₈	2.750	51.844	142.571	2.10	0.0147	0.4072	5 ¹ / ₄ x 9 ⁷ / ₈
94 ⁷ / ₈ -97 ⁵ / ₈	2.750	53.078	145.965	1.86	0.0127	0.3518	5 ³ / ₈ x 9 ⁷ / ₈

Note. It will be noted that this cross section shows greater seasonal differences in density than changes due to depth.

Another marker 1 mile south of Little America III was located (previously known as Station B) on the survey base line of 1940. The bamboo pole at this point projected 7 feet at the surface when first visited in 1947. An effort to dig down to this canvas was interrupted, however. The canvas was not struck at the depth of approximately 8 feet, although it was considered certain that the canvas could not be much lower. Prodding with rods did not reveal its loca-

tion and it is conceivable that the canvas had blown away or that the shaft dug down was not over it. It confirmed roughly the fact that the first measurement taken was a reasonably accurate measurement for the whole surface. Some other markers were located but most were completely drifted over.

The only other long term snow accumulation record of this type was made by Ernest Joyce who in 1909 discovered Scott's depot

After it had been abandoned 6½ years previously. He reported the annual rate of accumulation to be 38 centimeters (reference see Wade above). These figures agree reasonably well with those found by this expedition.

The accumulation rate of snow over Little America I and II appeared to be of the same order of magnitude, and on the first visit to this area the smokestack of the science building built in 1934 and well above the snow in 1940 was exactly flush with the surface in 1947. A slight depression in the top of the stack made it resemble a golf cup. A storm a day later was sufficient to erase once and for all the last surface indications of the position of this house. At Little America III the gables of the houses and the flat top of the snow cruiser, the highest objects in that area, were exactly flush with the surface, the highest point in that vicinity. The surface arched downward in all directions. Only a few major directional drifts were apparent.

A pit in the snow surface was dug beside

the science building of Little America III in the Antarctic winter of 1940. This pit was originally approximately 23 feet deep. The depth of the pit as measured in 1947 had shrunk to approximately 16 feet. This cannot be considered entirely due to normal weight, for in an area surrounding the point there was a surface accumulation of nearly 15 feet, including the science building and the snow drifts around it. This weight added appreciably to the compression of the pit walls. Detailed investigation of the pit was made by Mr. Howard which will be described in the reports of the United States Geological Survey.

The compression of the surface is probably a greater force causing destruction of buried buildings than lateral pressure. The effect on the buildings of Little America I and II was to cause the floor to come up, the roof down, and the walls to bulge inward. At the same time a snow room made in 1934 about 15 feet below the surface appeared in 1940 unaltered except for slight diminishing in size.

CLOTHING AND FOOTGEAR

EXPERIMENTS

1. General.

Certain radical clothing experiments were carried out by the Dr. Siple while in the Antarctic regions. These experiments were a continuation of earlier research under OQMG during World War II. The primary studies included body clothing and footgear.

2. Hand-Made Sponge Rubber Suit.

a. It has proved difficult for industry to construct a suitable spacer to lie between the body surface and heavy clothing lying over it. The desirability of such a spacer is to serve as a ventilating space which will prevent any liquid body sweat from passing into the clothing to deteriorate its insulating properties. On the trip south several volunteers, including Commander Watson, Captain Wiener, Lt. Richard Byrd, Jr., and others, helped Dr. Siple to construct a special hand-made suit. The suit was made of three-eighth inch blocks of sponge rubber cross threaded on thin rubber bands with intervening spaces of one-quarter to half an inch. This fabric was formed into a slip-on shirt with a turtle neck, wrist length sleeves, and sufficient length to hang well below the hips. A corresponding pair of drawers to ankle length was started but never completed. The suit was first tried out when the sleeves were only a few inches below the shoulders. The rubber suit was worn over the skin and covered by a close fitting Byrd cloth shirt. On top of this were worn regulation Army parka, pile and parka, cotton, O. D. on the outside. Other gar-

ments were regulation Army winter combat type. The suit was used during a ski run across pack ice on a windy day with temperatures about 25° F. The assembly was comfortable, although more than required for the temperature and exercise. Ventilation was achieved by leaving the parkas open at the waist, neck, and sleeves.

b. At the completion of the trip when the outer parkas were removed, it was noted that the inner windproof Byrd cloth shirt was dry everywhere but on the lower arms where the spacer was lacking. Long sleeves were added before it was used again.

c. The rubber spacer shirt was worn on many succeeding exposures with essentially the same results. Its advantages were—

(1) Because of the good ventilating system, heavy clothing could be kept on inside tents and shelters without danger of sweating.

(2) The sensation was one of quickly achieving acclimatization which normally requires 2 or 3 weeks.

(3) The suit was comfortable and easily ventilated to regulate sweating without removal of excess clothing.

(4) The suit did not noticeably irritate the skin and was slept in with comfort. There was no cutting in as compared with the Norwegian Brynji Vest.

d. The disadvantages were—

(1) The suit was crudely constructed and a bit difficult to put on.

(2) The points of the rubber blocks left some marks on the skin. These would be eliminated if balls (as desired) were used.

(3) Some moisture was retained in the sponge blocks. This could be eliminated by a dipped skin of rubber over each ball or block.

(4) At temperatures well below zero Fahrenheit, under conditions of strong wind, the control of ventilation of the outer clothing was insufficient to prevent chilling. This could be corrected by compatible designing.

e. It was found that reasonable success could be achieved by wearing the double faced pile parka over the naked skin. The elimination of wool underwear and shirt was found to be desirable. This method of dressing at very low temperatures on windy days proved insufficient also because the ventilation could not be adequately reduced with the designs available.

f. It is recommended that further experimentation be made with rubber ball spacers and that an impervious layer be used over the top to make positive prevention of body moistures getting into the insulating garments. Body moisture would be bypassed out the neck and other openings by ventilation and vapor pressure differential.

3. Footgear.

a. During most of the stay on the ice, Dr. Siple wore experimental footgear. The favored design for the coldest conditions included the following, from foot outward:

- (1) Sock cushion sole.
- (2) Experimental rubber sock, knee length.
- (3) Socks, felt.
- (4) AAF flying boots, fleece lined.

b. The advantages were—

- (1) Superior foot comfort.

(2) Drying of footgear reduced to the cushion sole sock and interior of rubber sock.

(3) Speed of dressing feet.

c. The disadvantages were—

(1) Combinations being experimented with; all different in length.

(2) Speed of dressing would have been greatly improved had the inner rubber lining been attached to the outer boot.

d. The combination was used on long flights in unheated planes where the crews were subjected to little activity. The combination was found to be equal if not superior in comfort and protection to fur mukluks.

e. It is recommended that OQMG continue its development of the double vapor barrier boot to replace the shoepac in wet, cold, and very cold areas. The development will increase comfort and protection, eliminate the heavy wool ski socks, and greatly reduce drying time.

4. Mask, Type X.

a. Both Mr. Davis and Dr. Siple tried out the Mask, Type X at temperatures below 30° F. in wind. The added efficiency was immediately apparent and added greatly to the protection of the whole clothing assembly. The effect was so pronounced that it was apparent to both that clothing previously felt inadequate could have been reduced for comfort.

b. It is recommended that Mask, Type X be improved from the production design standpoint and standardized. Further, that sufficient amount be purchased to be placed in the Arctic stock pile.

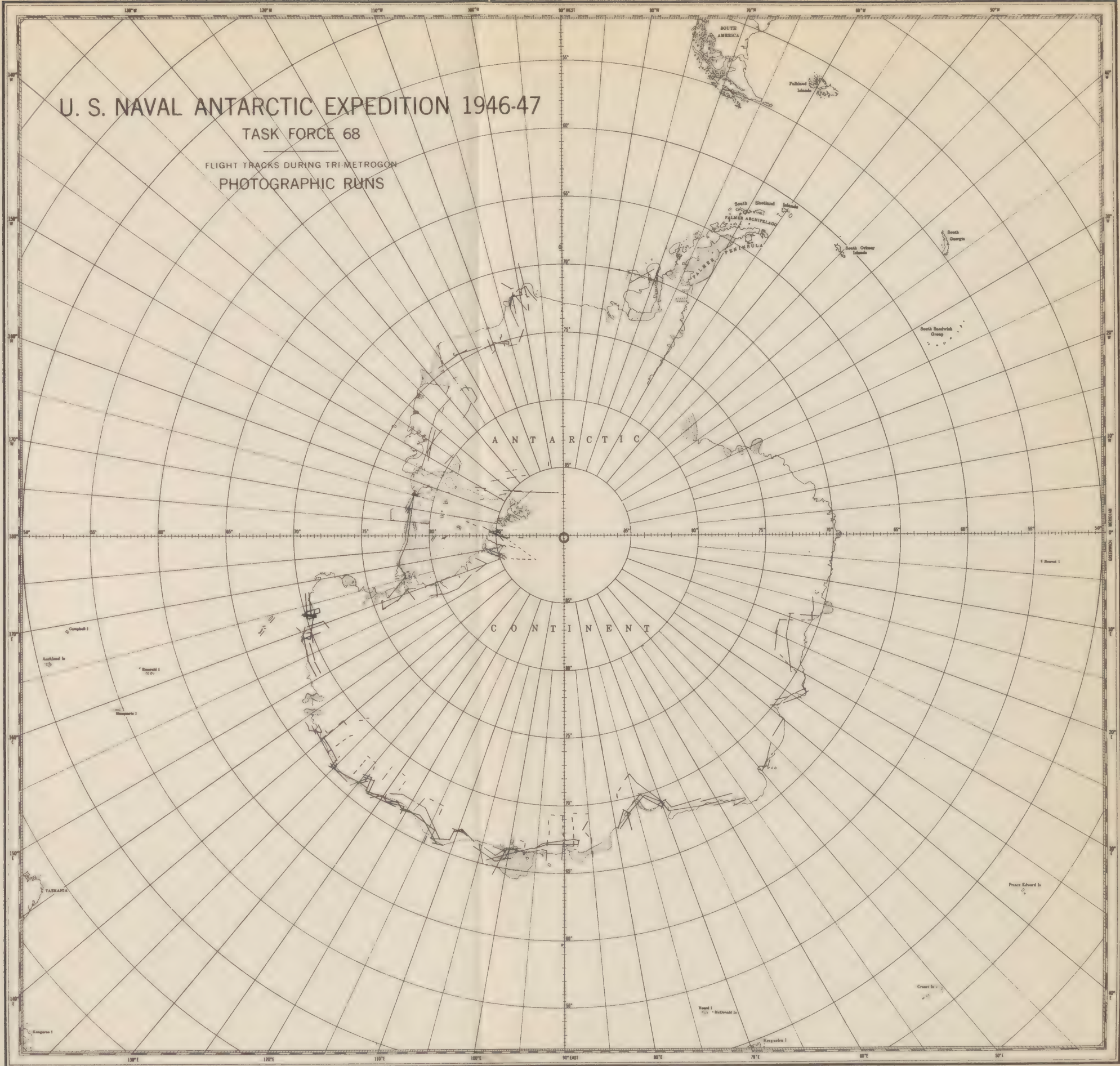
APPENDIX VIII

MAPS

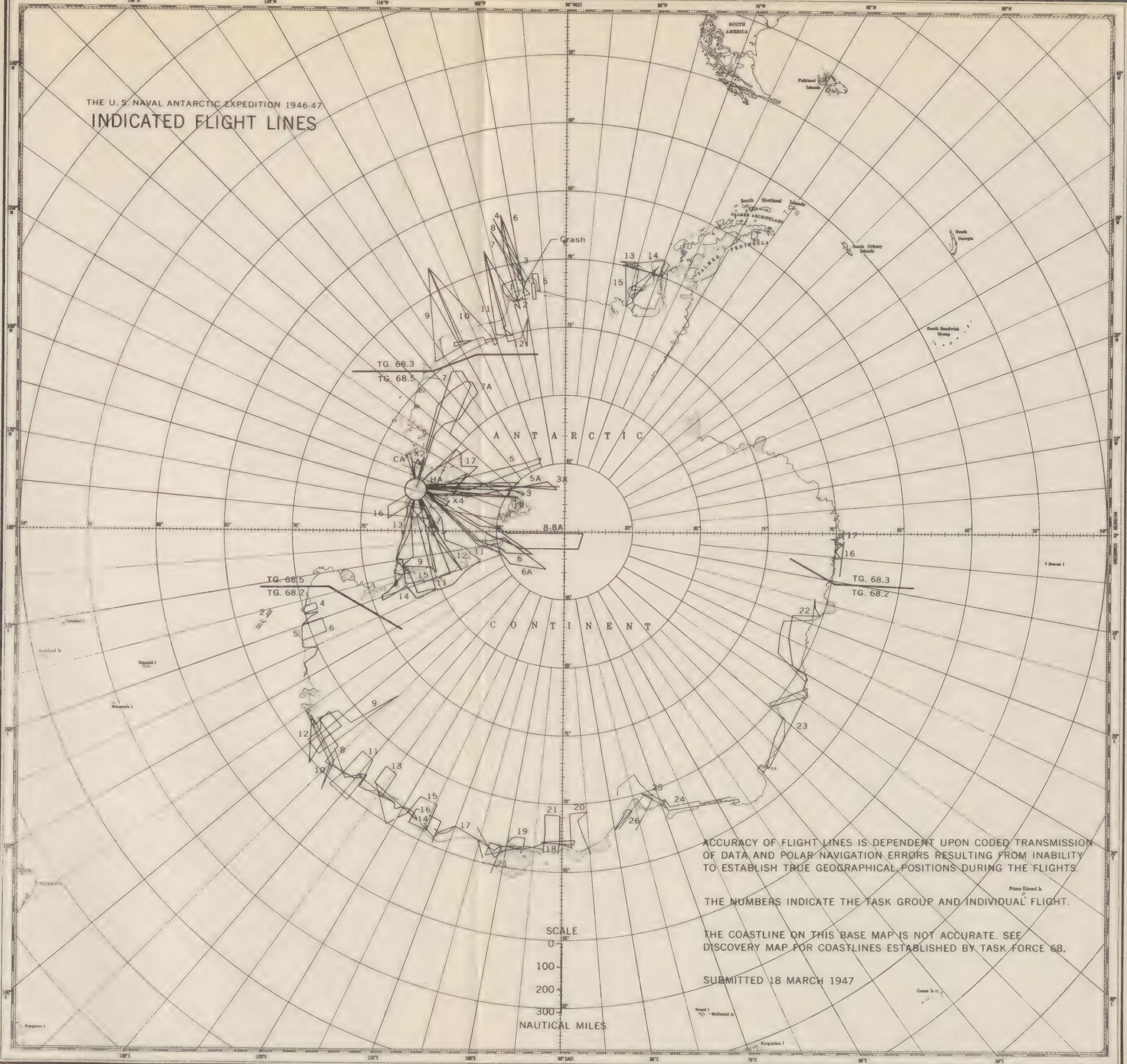
U. S. NAVAL ANTARCTIC EXPEDITION 1946-47

TASK FORCE 68

FLIGHT TRACKS DURING TRI-METROGON
PHOTOGRAPHIC RUNS



THE U. S. NAVAL ANTARCTIC EXPEDITION 1946-47
INDICATED FLIGHT LINES



ACCURACY OF FLIGHT LINES IS DEPENDENT UPON CODED TRANSMISSION OF DATA AND POLAR NAVIGATION ERRORS RESULTING FROM INABILITY TO ESTABLISH TRUE GEOGRAPHICAL POSITIONS DURING THE FLIGHTS.

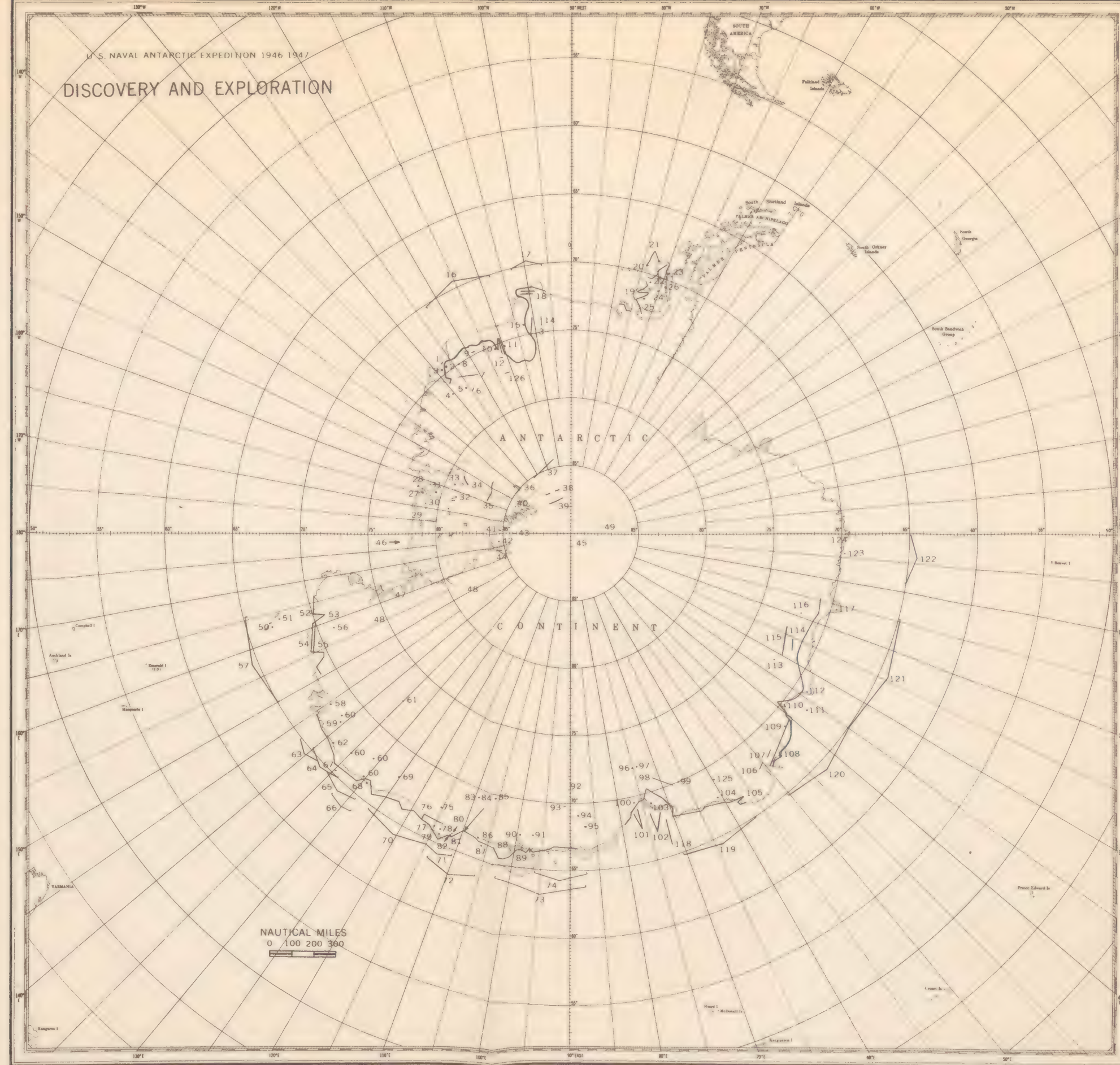
THE NUMBERS INDICATE THE TASK GROUP AND INDIVIDUAL FLIGHT.

THE COASTLINE ON THIS BASE MAP IS NOT ACCURATE. SEE DISCOVERY MAP FOR COASTLINES ESTABLISHED BY TASK FORCE 68.

SUBMITTED 18 MARCH 1947

SCALE
0
100
200
300
NAUTICAL MILES





- Two small islands, exposed rock, elevation 500 feet.
- Mount Ruth Siple relocated here, 15,000-foot elevation confirmed.
- Open water west and southwest of Mount Ruth Siple indicates George Getz shelf ice nonexistent in this locality.
- and 5. High mountain sighted here from distant aircraft.
- Two high mountains, approximately 16,000 feet.
- Mountain range 9,000 feet, plateau to south 8,000 feet.
- Large firm field inland from coast from 121° to 128° W., 2,000 feet.
- Mountain, 35 miles inland, from 117°30' to 118°42' W., 5,000 feet.
- Five mountains, elevation 3,000 feet, centered at 75°14' S. 111°40' W.
- Mountain range, elevation 3,000 feet, extends along 110° W.
- "X-Ray Mountain Range" elevation from 2,500 feet in west to 15,000-foot peak of Mount X-Ray at the eastern extremity.
- Mountain range, 35 exposed peaks, 85 miles long, elevation rises from 2,500 feet in the north to 5,000 feet in the south.
- Five mountain peaks, estimated elevation 6,000 feet.
- Five small islands, exposed land, 400 yards long, 700 feet high.
- This coast line is snow-covered with patches of brown land exposed. Open water along shore inside of pack ice.
- Islands and glaciers discovered here. North part of peninsula defined by open water, west coast difficult to locate.
- Two parallel mountain ranges extend approximately east-west across the peninsula. (Noville mountains relocated.)
- Several islands discovered in this area.
- Monique Peak sighted, estimated 3,000 feet, but top in clouds.
- Open water on north coasts of Alexander I and Charcot Islands.
- Ice covers Wilkins Strait joining Alexander I and Charcot.
- Southern portion of Marguerite Bay accessible to ships.
- and 25. Sighted mountain here.
- Location of Douglas range and other mountains on Alexander I Island are correct as previously charted.
- Additional data secured via aerial photography concerning speed and direction of movement of sectors of Ross Shelf ice.
- Kainan Bay formed by submerged island.
- Strong magnetometer irregularity indicates submerged island or volcanic dike under shelf ice at this point.
- Confirmed presence submerged island.
- Magnetometer confirms outline of submerged Roosevelt Island.
- Submerged island here (magnetometer).
- Submerged island thought to be here is either nonexistent or of sedimentary rock structure.
- East coast of Ross Sea discovered under ice cover.
- Distinctive snake-like belt of disturbed ice.
- Mountain group with plateau to south.
- High mountain range with foothills to north.
- Mountain range, elevation 9,000 feet, with saddle pass.
- Mountain range, elevation approximately 13,000 feet.
- Discovered glacier descending from polar plateau.
- Interior and upper reaches of Wade glacier explored. Mountains and tributaries to Wade glacier discovered.
- Explored mountains between Wade and Beardmore Glaciers.
- Small group of mountains approximately 10,000 feet located here.

- Explored tributary glaciers and mountains of Beardmore area.
- Revisited the South Pole, exploring beyond it from Little America.
- Discovered changes in ice front, tension cracks, pressure, etc.
- Explored dry glaciers, ice lakes, streams and falls, Devil's Postpile, etc., here.
- Explored and mapped entire western and central portions of mountains bordering west coast of Ross Ice Shelf. Nothing but polar plateau visible west of mountains.
- Polar plateau level and featureless to extent of visibility.
- Buckle Island mapped, peak elevation 3,900 feet.
- Russell Peak on Sturge Island 8,500 feet; island mapped.
- Mountains 8,000 feet high between Capes Cheetham and Williams, higher mountains to the south and a very high rolling plateau inland.
- Rennick Bay extends inland to 71°30' S.; both sides lined with mountains up to 8,000 feet.
- Scattered low mountains in the vicinity of Archer's Point.
- Oates coast lined with mountains up to 10,000 feet in elevation.
- Rolling ice plateau averaging 6,000 feet in elevation.
- Several new islands and glaciers found along this rugged terrain coastal area.
- South Magnetic Pole may have moved here (inexact aircraft compasses).
- Ice cap elevation 8,500 feet and featureless except for rolls and a few sharp rises.
- Featureless ice cap areas.
- Ice cap elevation 9,500 feet and absolutely featureless.
- Valley or glacier extends along 138°30' E., from beyond horizon to the sea.
- Loose pack, easy access to the coast with an ice breaker.
- Solid pack with no leads from Davis Bay to Cape De-couverte.
- Dense pack and occasional open bodies of water in solid pack.
- Close pack of small floes offshore, scattered collections of icebergs.
- Ice Lake 20 by 50 miles located here
- Porpoise Bay discovered to be much deeper than previously known.
- Ice cap elevation 6,500 feet. No mountains or glaciers visible from here.
- Loose pack, navigable by ice breaker at any point.
- Open water along coast as far out as visibility (15 miles).
- Many small islands and many nunataks along coast; no mountains.
- Actual coast line, this area does not agree with existing charts.
- Open water in Davis Sea from 92° E. to the shelf ice.
- Ice cap rises to a great elevation west of 115° E.
- Ice cap less than 1,000 feet in elevation in this area.
- Two large glaciers here.
- Ice cap forms dome at this point, rising to 5,000 feet.
- Ice cap elevation 2,700 feet.
- Outcrop of black earth (possibility of coal?).
- Deep embayment at 110° E.
- Glacier, rust-colored land outcrops discolor glacier and its bergs.
- Largest glacier in group, sheer drop of 1,000 feet.
- and 86. Glacier.
- Excellent landing field accessible to protected ships.

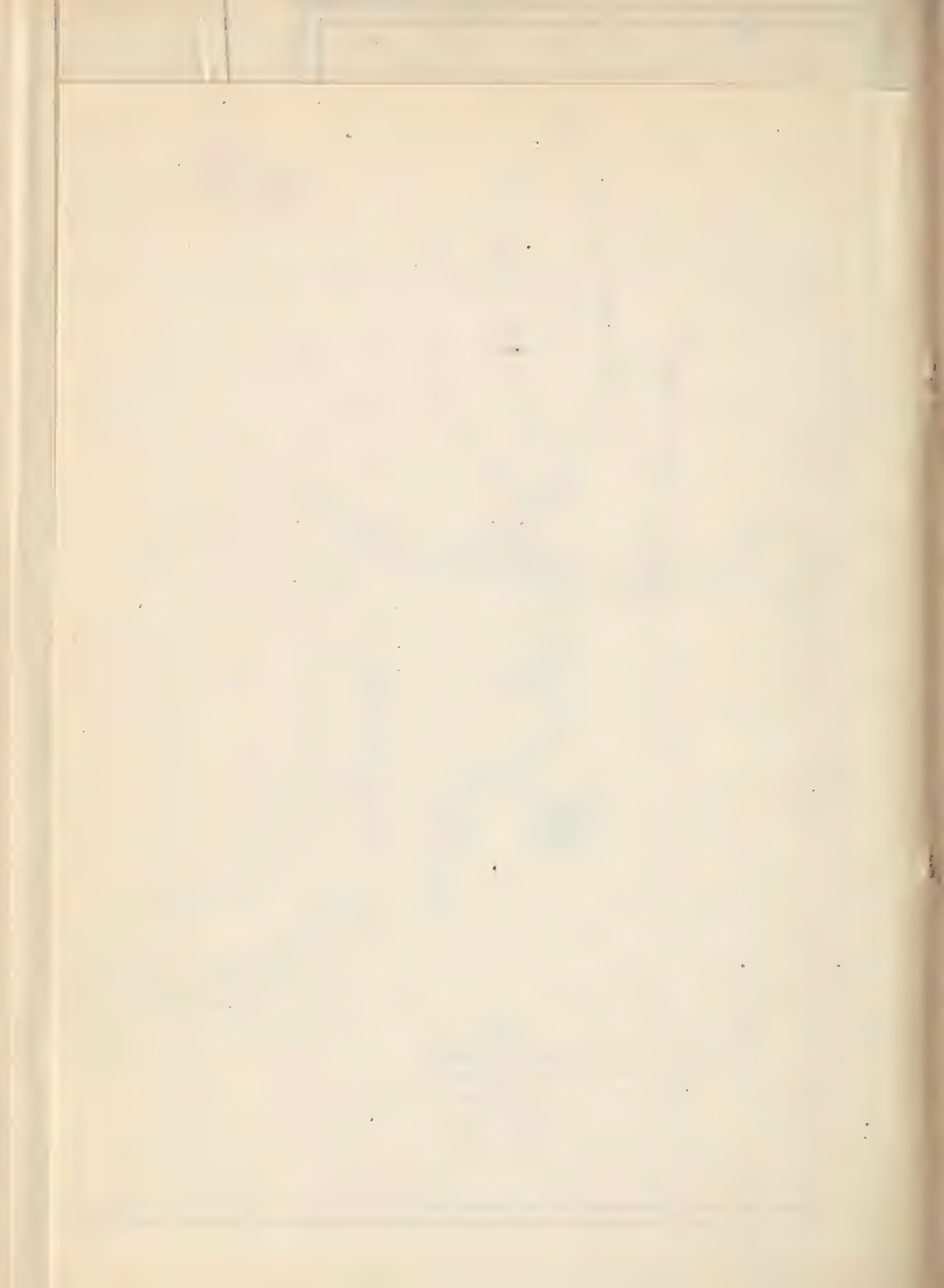
- Discovered narrow ice tongue.
- Several nunataks here.
- "Bunger's Oasis," 20-mile circle of ice-free hills 500 feet high and cone-shaped.
- Denman Glacier extends south to 67°35', rimmed by 5,000-foot mountains.
- Ice cap elevation 6,000 feet.
- Mountains sighted here protruding several thousand feet over ice cap.
- Ice cap elevation 8,300 feet.
- Ice cap elevation 8,000 feet.
- Nunatak discovered here.
- Large group of mountains.
- Ice cap elevation about 8,000 feet.
- Prominent mountain range.
- Prominent mountain range.
- Sorsdal Glacier much longer than described.
- South coast of Mackenzie Sea is open water.
- Shelf ice 200 feet high.
- Mountain indicated here on existing charts does not exist.
- Ice cap elevation 20 miles in is 3,500 feet. Ascent continues.
- Edward VIII Gulf much larger than charted, has split glacier.
- Scott Range 6,000+ feet, top obscured.
- Mountain range.
- Large glacier discovered here.
- Maximum elevation along this line is 4,000 feet.
- Glacier and shelf ice to the north.
- Thorshammer Island is nonexistent.
- This peninsula actually is shelf ice.
- Sighted mountain range here.
- Lower and less well defined mountain range.
- Mountain range 13,000+ feet; ice cap to north 5,000 feet.
- Payer group of mountains misplaced. The plane flew nearby in good weather but did not sight it.
- Location of ice tongue confirmed.
- Open water to ocean, except for very loose pack.
- Previously known coast line remapped and confirmed. About half of this coast has open water inside loose pack ice.
- Nunataks along edge of coast.
- Actual coast line here lies 30 to 45 miles south of that plotted on existing charts. The former coast line was actually the ice boundary as demonstrated by the aircraft radio altimeter.
- Consolidated pack off coast. Cloud cover from 0 to 14,000 feet over the continent prevented exploration.
- Shelf ice extends north of coast to 69°55' S. between 3° and 4° E.
- Probable rock [garbled word], apparently of volcanic origin.
- Prominent mountain range sighted here.
- Mountain range sighted here.

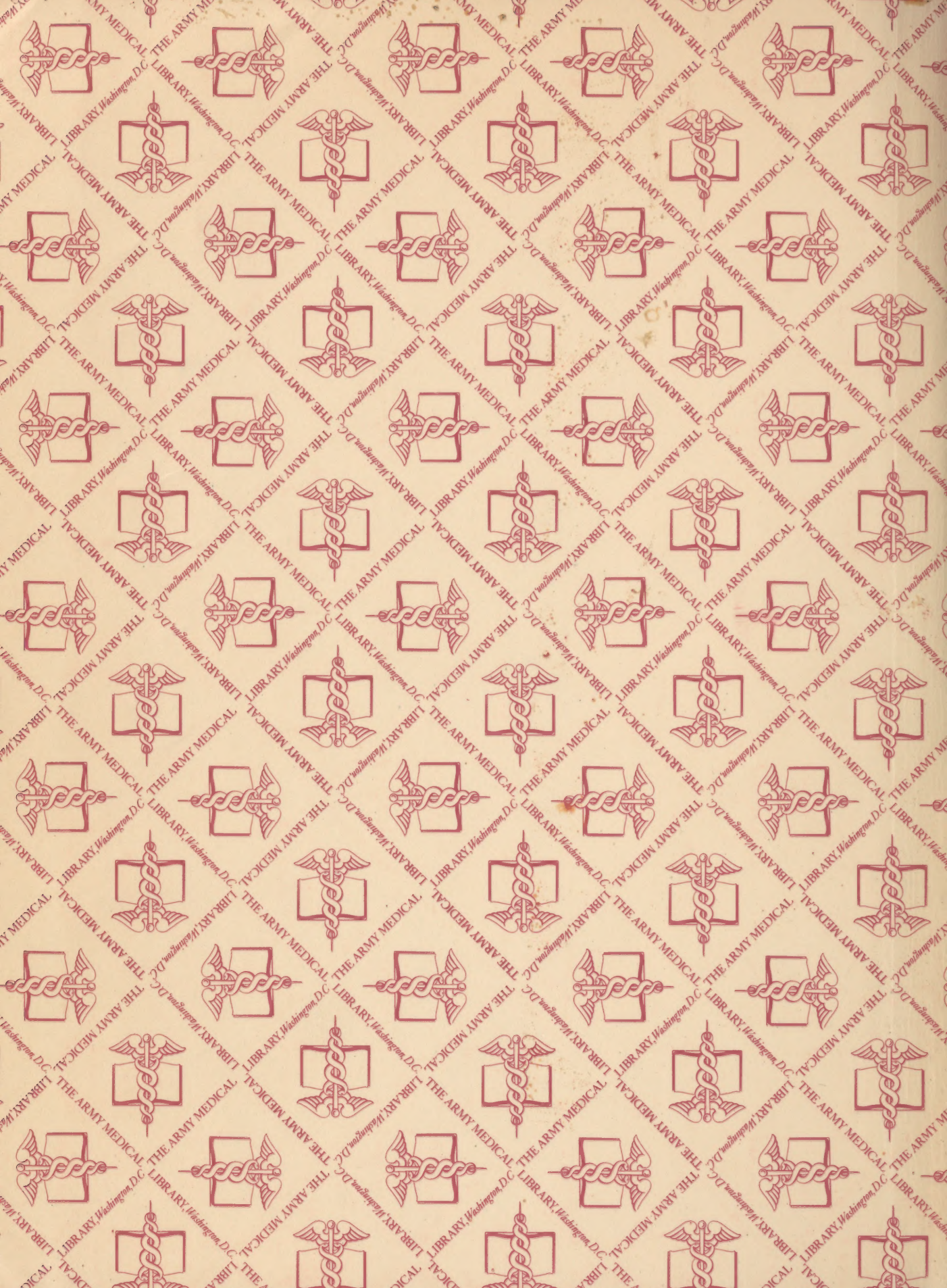
Note. The comments listed hereon are excerpts from coded dispatches, from interrogation of aircrewmembers, or from casual examination of aerial photographic proofs (Task Group 68.5 only). At this date the mapping photography has not been prepared or examined.

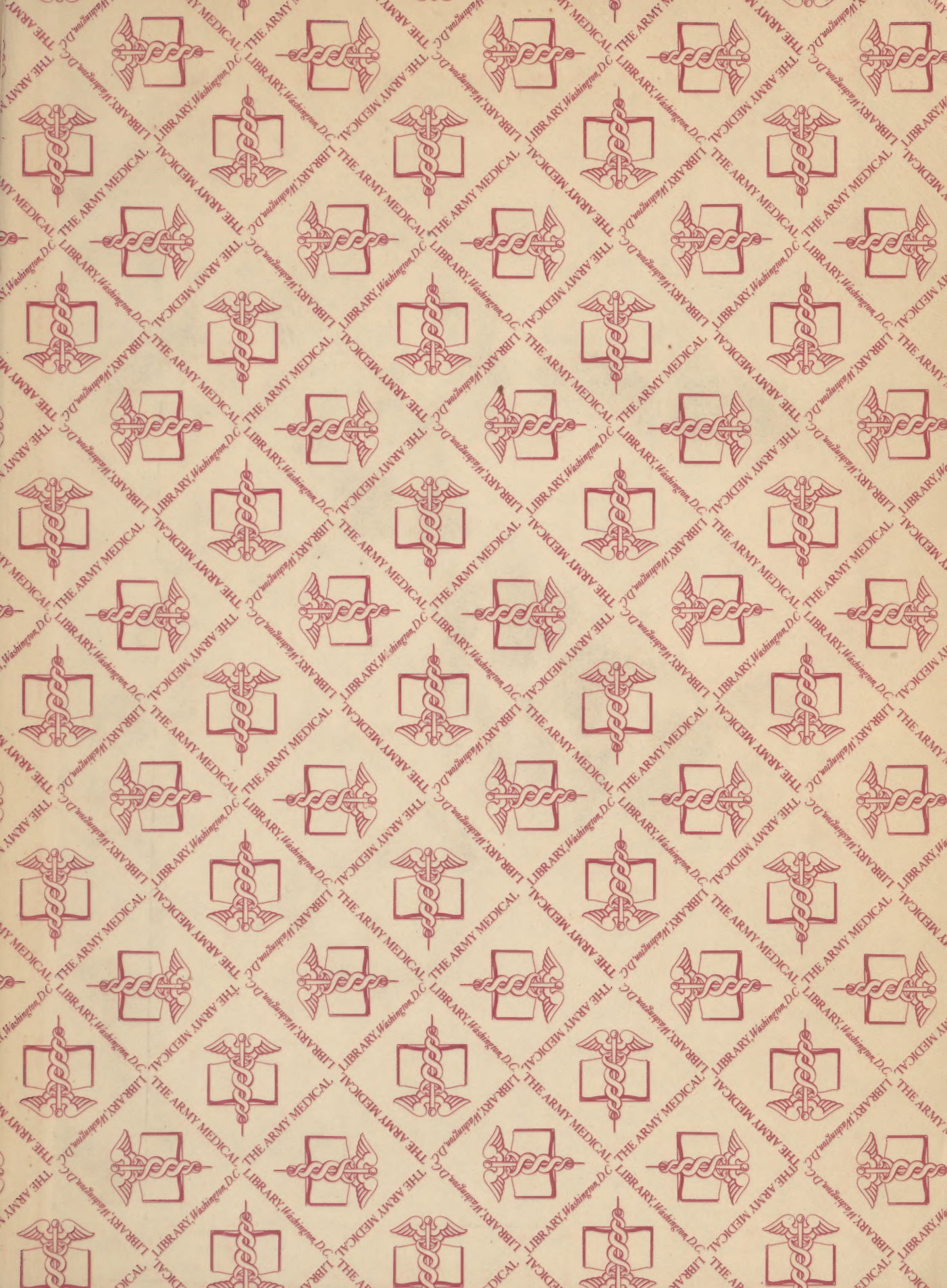
This preliminary edition submitted 18 April 1947.

John H. Roscoe, 1st Lt., U. S. M. C. R.,
Staff Photogrammetric Officer.









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